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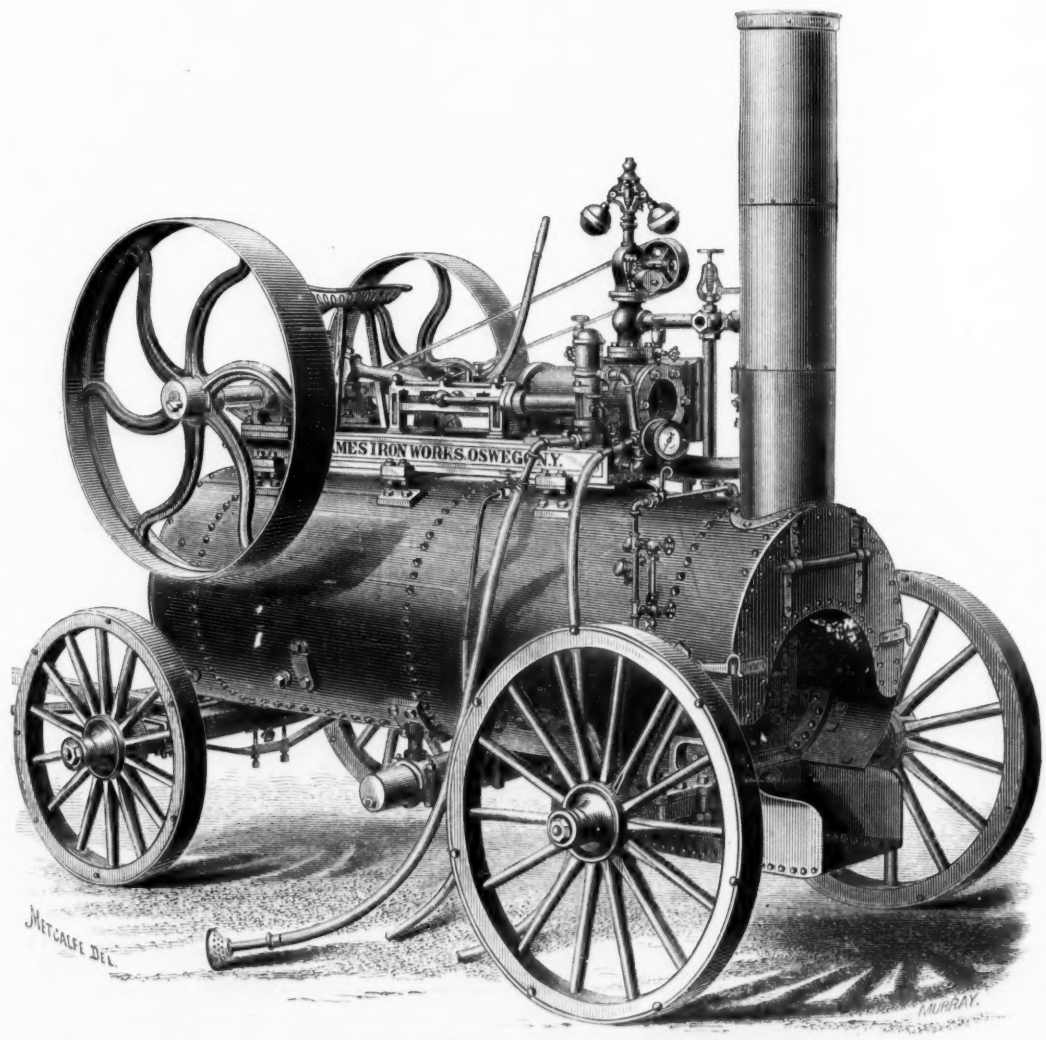
Portable Agricultural Engines.

We illustrate, herewith, two portable steam engines, which are built by the Ames Iron Works, of Oswego, N. Y., and 38 Cortlandt Street, New York City. The Improved Threshing Engine, shown in the illustration, is intended for farm and other purposes, where a portable engine is desirable. The boiler is of the locomotive pattern, with an ash-pit formed at the bottom. This engine is strongly mounted upon either iron or wooden wheels. If of wood, the spokes are made of oak and the felloes of birch, all strongly bolted together. A tire of 6″ in width is generally used for sandy or soft localities. The bolster is placed under the end remote from the furnace, so that most of the weight is thrown upon the back wheels. The axle, which is made of the best iron, is in one piece, and is curved to fit the boiler, passing under the ash-pit, thus making a very much stronger axle than if it were merely abutted against the sides of the boiler, and bolted to it by means of tap bolts. The axle is also strengthened by brackets bolted fast to the boiler, which fit over the shoulders on each side. Injury to the boiler from sudden shocks is thus prevented. A dry pipe is made use of, in order to get dry steam, and a spring balance is used on the safety valve, instead of a weight. The engine is furnished with a good, plain slide-valve, which, in an engine of this sort, subject, necessarily, to rough and unskillful handling, is considered to be less liable to get out of order than a more complicated valve motion. It is substantial and well proportioned. The guides are of an improved design, and are not liable to spring. The pump is provided with a suction hose, which is fitted with a hose strainer. A hose is also attached to the pump, by which water may be used about the machine for any necessary purpose. The smoke stack is hinged, so as to turn back upon the engine while being transported. A spark arrester is placed in the top of the smoke stack, and consists of a round frame covered with fine wire netting. This frame is pivoted like a damper, and fills the opening in the top of the stack. It can be opened, should occasion require, to give a better draught, or it will, by a quick movement, remove any accumulation of sparks or dirt in the screen.

The Straw Burning Engine shown in the cut, although new, has been extensively used in the Western states and some parts of South America, where other fuel is scarce and expensive, and straw is plentiful. Its design is the result of long and careful experiments. It is said to work successfully, and its builders claim that straw is an economical fuel where the price of a ton does not exceed that of a cord of wood. The boiler is constructed on the return flue principle, with one large flue running the entire length. The fire-box, which is furnished with grate bars, occupies about one-half the length of this tube, the ash-pit portion being beneath, and easily accessible. The straw is introduced into the furnace through an ordinary fire-door in front, and the fire and heat pass through the large tube to the back connection. The heat then returns through a series of small tubes, which are located above and on either side of the large tube, thus obtaining perfect combustion, as well as utilizing most of the available heat. The escape from the smoke-stack is, principally, superfluous gases. The proportions for a boiler 38″ in diameter are as follows: Large tube, 15″ diam. and 26″; small tubes, 2½″ diam. and 90″ long. In this way, the danger from fire is claimed to be avoided. The boiler is fitted with a peculiarly shaped mud drum, through which most of the deposit and dirt from the boiler are removed. The engine is very much the same as that of the engine previously described. This boiler can be readily adapted for burning either wood or coal by a simple change in the grate bars.

IMPROVED THRESHING ENGINE.



STRAW-BURNING ENGINE.

A Machine for Grinding Chilled Car Wheels.

An important railroad invention has lately been brought out in the machine shops of the Virginia and Truckee Railroad in Nevada. It is a machine for grinding chilled car wheels, both old and new, removing all inequalities of surface and trimming them to a uniform smoothness of tread. Great difficulty has been experienced in finishing car wheels with a perfectly true outer circumference, free from blisters, lumps and uneven places. Previous to the invention of this machine, it is claimed that this was impossible. If, when a wheel is new, these inequalities exist, they increase after running some length of time, and it must, sooner or later, be flung into the scrap heap, thus greatly augmenting the cost of repairs beyond what it should be. In roads abounding in steep grades and sharp curves, this flattening of car wheel circumferences is a very serious difficulty.

Under the sagacious direction of Mr. H. M. Yerington, superintendent of the Virginia and Truckee Railroad, a series of experiments was instituted at the Carson shops, some two years ago, having as an end in view the elaboration and perfection of certain ideas suggested by Mr. James Gowan, general master mechanic in the employ of the company at that time.

After considerable experimenting, the problem was solved by the

production of a machine which accomplishes the desired result, and is said to be unrivalled for simplicity of design and smoothness of action. It is proposed soon to establish a manufactory of these machines in Chicago.

How Paper is Made.

(Concluded.)

After the washing process is completed, the rags are drained and then put into a beater, where they go through the gradual process of being completely reduced to a pulp. This operation has been compared to a woman scraping lint, and the more time taken in the reduction, and the nearer the pulp approaches to the consistency of cotton, the more valuable will the paper be. The process usually takes about twelve hours; but in the manufacture of bank-note paper and other papers of strong fibre, the time taken is, in most cases, twenty-four hours. The knives are brought gradually nearer to each other, until the reduction is completed.

The cylinder washer is now raised out of the way, and some bleaching powder, which is generally chloride of lime, together with the "sizing," if the paper is to be what is known as "engine-sized," is now put in. The sizing used is rosin cut with alkali; or, in other words, rosin soap, and is called vegetable size. This "size" is added for the purpose of filling up the pores of the material, and of preparing it to take a smooth finish. If the paper is to be colored or tinted, the coloring matter must also be put in at this time. Without adding any more water, the pulping process is allowed to go on for a half hour longer, in order that the mixing process may be complete at the expiration of which time the beater is stopped. A little plate in the bottom of the beater is then lifted, and the whole contents of the tub are at once transferred to a bleaching or draining vat, which is located under each beater, and which is simply an arched brick vault with a grating in the bottom. The pulp is allowed to remain in this vault about a week or ten days. Every time the beater is thus emptied (for each vault will hold several "beater-fulls"), the bleaching liquor filters down through the mass, so that the bleaching process may be more complete.

The pulp at the end of ten days can hardly be distinguished from cotton, its fibre being so fine and white. It is a matter of argument among paper makers as to how long the pulp should be allowed to remain in the vaults, some claiming that the pulp and sizing are injured by lying too long. At the proper time, the pulp is taken from the vaults and put into stuff-chests, which are large tanks with an upright shaft in the center. To this shaft are attached arms, which, as they revolve, agitate the pulp, thereby making with the addition of water a homogeneous liquid. It is now necessary that the pulp be kept constantly in motion, in order to get an even quality of paper. It flows from the stuff-chests down, by its own gravity, to a fan-pump which agitates and throws it up again in a continuous stream, when it passes forward through a box or trough about fifteen feet in length, in which are placed low partitions, which, as the pulp flows over them, will catch any large pieces or dirt between them, until it finally runs into the vat placed at the end of the paper machine. The flow of pulp is regulated by a suitable gauge, and passes through a fine wire strainer on top, or fixed in the bottom of the vat, which removes any grit that may have found its way in with the water.

The paper machine now in general use is known as the Fourdrinier machine, which takes its name from its French inventor. It is illustrated in Fig. 5 as completely as our space will permit; the details of its construction are found in "A Practical Treatise on Paper Making, by Carl Hofman." This machine is very simple in its construction, and is connected with the pulp vat A, previously referred to. The pipe through which the pulp passes is attached to the bottom of this machine, the pulp flowing from the vat over an apron, and spreading upon an endless wire gauze belt, about 32 feet in length, which runs over two rollers, one of these being near the vat, and the other being the bottom roll shown at B. A surplus of pulp is kept constantly coming into the vat and flowing over into the pump, so as to prevent settling.

FIG. 5.—FOURDRINIER PAPER-MAKING MACHINE.

The pulp is prevented from flowing over the edges of the wire gauze by two endless rubber belts, $1\frac{1}{2}'' \times 1\frac{1}{2}''$ square, placed near them. These belts are called "deckle straps," and run upon the pulleys D, D, by which they are pressed firmly upon the gauze. They are arranged so that they may be set any distance apart, and act as a gauge for the width of the paper required. The pulp, after filling the space between the deckle straps, is carried forward over the frame by means of the wire gauze on which the paper is formed. The water runs through the gauze upon the drain, or "save-all" E. It passes over two suction boxes F, F, to which are attached two fan pumps, which suck out most of the water that remains in the pulp as it passes over the tops of the boxes. The frame mentioned is pivoted at C, and is kept constantly agitated by a suitable device. This agitation is greatest at the end D, continually growing less until it ceases entirely at the pivot C. This is done in order to distribute the pulp evenly and to secure a uniform thickness of paper. A dandy roll made of wire is placed near C, upon the surface of which is attached any brand or trade-mark desired, known as the water mark, which may be seen in all good brands of paper, by holding the sheet up to the light, the paper receiving the impression in passing under this roll. The paper then passes between the couching rolls G, which squeeze out the remaining moisture. Continuous small streams of water are kept running on these rolls to keep them clean, and prevent the paper from sticking. It is now carried on to the press rolls H, by means of an endless belt made of felt. In this mill the belt is 24 ft. in length. The speed throughout this system of rolls must be very nicely calculated, as the least unnecessary strain brought upon the paper would destroy the sheet. It must be kept straight but not stretched. From the press rolls it passes on to the dryers I I, which are hollow iron cylinders, 28″ in diameter and 64″ long, steam being introduced into each one through the bearings. In the arrangement of rolls and dryers, more are sometimes used, and sometimes less, but the general principles remain the same.

The dryers are covered by a canvass belt which receives the paper between it and the dryers, and, pressing it against the hot surface, the paper is thoroughly dried by the time it reaches the last dryer. From the dryer it passes upon the calender rolls—a stock of which are shown in Fig. 6. These rolls are made of chilled iron and accurately ground, so that by subjecting the paper to a severe pressure between these rolls, it is finished. Where the paper is not engine-sized (nearly all news paper is engine-sized), it is run directly from the dryer to a slitting machine located at K though not represented by the cut), by which it is cut into strips of the proper width. From thence it passes through a vat of "size" and through the sizing rolls, which squeeze out the surplus sizing. The sizing here used, called "animal size," is made from raw hide, being nothing more than common glue, and is used mainly for writing and envelope paper. The manufacturing process proper is now completed, the paper being taken up by the cutter L, which cuts it into sheets of the proper length, and drops it in stacks upon the "lay-boy," or table, as shown. Thence it is taken to the drying loft, where it is hung upon poles, and left for about three days. This cutter can be readily adjusted to cut any size. The average speed for writing paper is about sixty feet per minute. Thick paper can only be run twenty feet per minute, while thin paper can be run seventy feet per minute. If the paper is to be used for news purposes, instead of being cut, it is wound into a roll and afterwards cut upon an improved machine shown in Fig. 7.

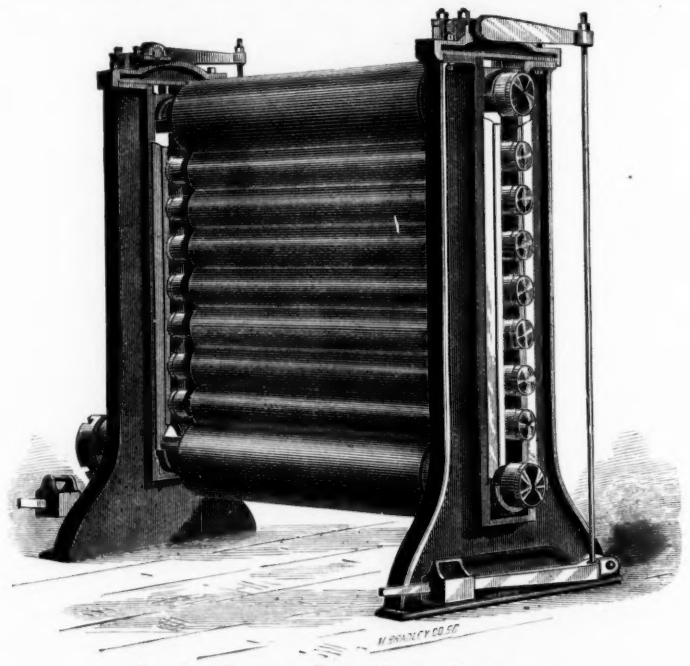


FIG. 6.—CHILLED ROLL PAPER CALENDER.

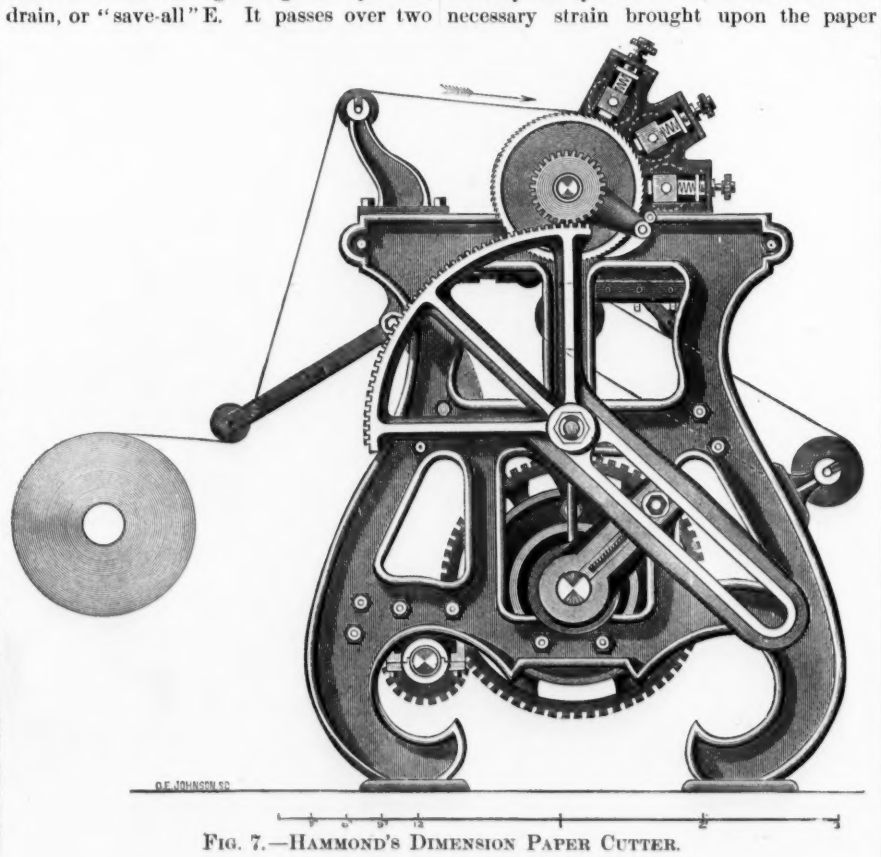


FIG. 7.—HAMMOND'S DIMENSION PAPER CUTTER.

This machine possesses great capacity. It is strongly built, with stands and girts of iron. The drum also is iron, and will not warp or spring. It also removes from the paper the electricity generated by the rapid motion of the rubbing surfaces of the machine itself, thereby avoiding much trouble in laying the sheets. The knife, having a sliding, instead of a rotary, motion, will keep a constant edge. Change of dimensions is quickly obtained, it being only necessary to change the length of stroke, which is effected by an adjusting screw in the crank-pin. A change of twenty inches can be made in two minutes. Little or no stock is wasted, either by the change of dimensions or in regular running. It is very rapid in its operation, cuts each sheet square and true, and requires a small amount of power. This machine has recently been much improved. When a very fine finish is required, the paper is run through a "web super-calender," as shown in Fig. 8. The stack of rolls is composed of four chilled iron rolls and three paper rolls, which are designated A, B, C. It is a very complete machine, being extra heavy in all its parts, with a reeling apparatus, all the stands for the paper being made to rest on the same level with the main frame. The principal feature of this machine is the method of driving the rolls. The mechanism consists of a friction or clutch pulley, for rapid motion, and a large friction wheel and pinion, driven by an independent belt from the main shaft, for the slow speed. It is operated in such a way that the speed may be changed from fast to slow, and the reverse, without stopping the rolls or loosening the pressure screws, thus saving much time and labor, and greatly increasing the capacity of the calender.

While this machine is running, strong currents of electricity are seen darting across the paper in all directions, resembling a miniature thunder cloud, while the noise attending it reminds one, forcibly, of the successive discharge of fire crackers on the fourth of July. In finishing heavy white paper, such as Bristol board, a plater is used—shown in Fig. 9. The sheets are each placed between two sheets of heavy paper, or, if a very fine finish is desired, sheets of zinc are used instead of paper. In this condition they are run through the plater, where they are subjected to great pressure, which gives them the fine finish required. It will be seen from the engraving that this is a most powerful machine, although it can be easily controlled.

There are many minor processes through which the paper must pass in order to finish it in the thousands of different shapes for the market, which are all interesting, but which our limited space will not admit at present.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * Pete & Cady have a shop in a town of twenty thousand inhabitants. Years ago their business was general. They did saw and grist-mill work, would contract for the iron work for a jail, receive orders for engines of ten to sixty horse power; kept a big stock of such weights on hand; could point to many nice jobs of store-front work; had a fair line of patterns for repairing everything used in their section; and they had made money.

They had about fifty thousand dollars invested, and worked about ninety men. They did good work, and got good prices. Pete was a machinist and a good one. Cady was a millwright and knew lots of things. They were good men in every sense of the word, square and honest, no lazy bones in their bodies, and with business faculties superior to the average. You will readily see that they owned a machine shop. They would build an engine, and it would be a good one. It would take them a good while to build one, but, when done, there was a margin.

These folks were not manufacturers, and, more than that, they had never seen any manufacturing done in their lives. Their business was local, with a slight tinge of reputation abroad in connection with their number four circular saw mill. Their work came to them, and they figured on it, and did it, if they got the order. If they got a whiff of a possible job, Cady would put on his good clothes, and go, say, fifty miles, and labor with the party. They did work only when they had the order. They had made money and had a surplus. Pete was foreman in the machine shop in particular, and superintendent of the concern in general. Cady was in the pattern shop, when not engaged outside. The shop was located in the Middle States, and was booming when the panic struck the trade.

* * * * The panic made things blue around the establishment of Pete & Cady. Few men, little work, contemptible wages, and the shop losing money. Like a thousand other men during the panic, they held a council, and decided that they were engaged in a line of trade greatly overcrowded. They must hunt up something to make which would keep them busy, and make it pay. They looked around, and struck on the last thing for a panic-stricken shop to engage in, to wit: small semi-portable steam engines.

What led them to it no man knows. Pete said, in gloomy council, "We have all the tools required in this little engine business; we know all about steam engines; we can make them up without orders and sell from stock; lots of these things sold."

You see, Mr. Editor, these boys were hatching up a manufacturing conspiracy. They thought that manufacturing consisted in simply engaging in a line which would permit a stock to be carried to fill orders from, as distinguished from a line of business dependent on special orders to fill. They looked no deeper. They didn't know it was any deeper, or they wouldn't have gone in.

* * * * After the conception, and a long period of incubation, there stood upon the shop floor an elegant, little eight-horse power upright engine, just hatched. It was a machine that the purchaser would be satisfied with, and one that would be a credit to the builders.

* * * * They pitched in and built twenty, following the same plan of "manufacture" they did with a single engine. They knew just what they cost. They advertised far and wide, giving a price, leaving but little margin. A month of advertising and not a sale—not even a real earnest inquiry; nothing but postal cards from triflers.

This worried the boys, for they knew such engines were being sold by hundreds. Some friend told them their price was too high, and scared inquirers away. They answered that their engine was something extra good. Friend said, the distant engine needer did'nt get to see the engine; he only saw the price.

* * * * They changed tactics, and advertised larger than ever, but omitted any mention of price. This brought heavy mails, and in response they quoted a price ten per cent. off list. They made a few sales out of all proportion to the mails. They cut another ten per cent., and sales slightly increased. Still the business amounted to nothing, and there was nothing in it at twenty off.

* * * * The twenty engines were finally gotten rid of, and the question arose as to the desirability of building a new lot. Cady had charge of the disposal-end of the new scheme, and had got thoroughly worked

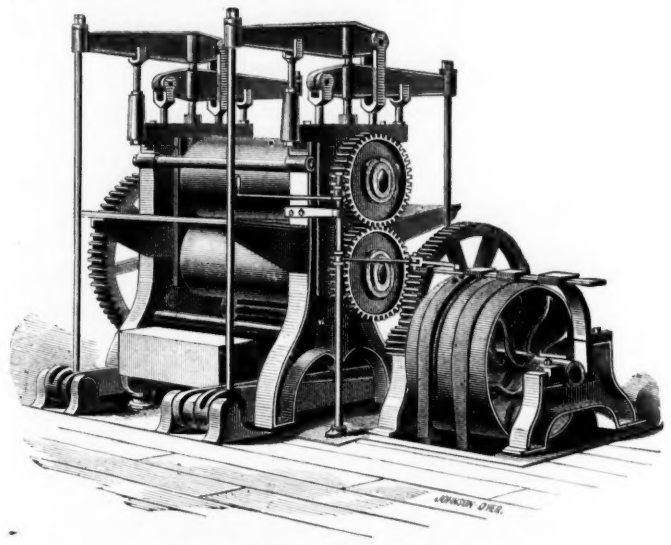


FIG. 9.—EXTRA HEAVY PLATER.

up. He insisted on the engines being cut down in merit till they could stand simply even with others in the markets. "If others use boilers too small for the engine, we must do the same," said he, "and we must overhaul the whole thing on the same plan of economical design."

"Next," said he, "we must have the work done by the piece; that's the way other makers do. Then we must rig up for the work. These things taken together must justify another twenty per cent. cut, and then everything will be lovely. There are lots of these engines sold, and if we can only get our share of the trade, we don't need any other work." Pete coincided in the scheme, and things were pushed. The engines were redesigned; what seemed like marvelously convenient jigs, etc., were got out; the men were put on a piece-work price, which drew

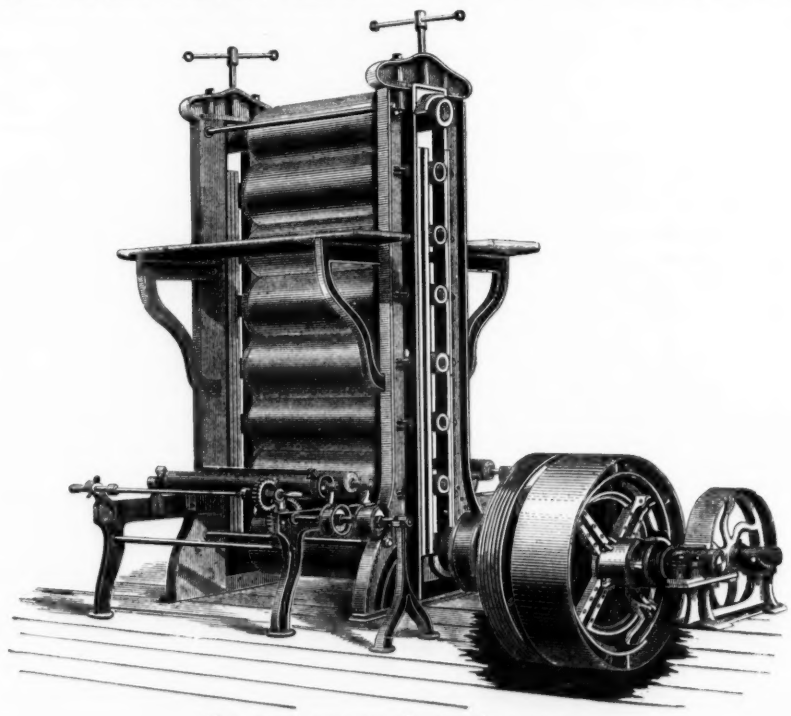


FIG. 8.—IMPROVED SUPER CALENDER.

the sweat, and a new lot of twenty was begun.

* * * * The castings were out, the boiler iron on hand, and a piece-work price put on every piece, so it was known just what these engines would cost. Cady looked at the figures—looked solemn; said it wouldn't do at all. Even at this price, their cost was still slightly above the selling price of some competitors. Said Pete must be handling things wrong, or he could get the thing down lower. Pete flared up and said the thing couldn't be got any lower. The material would not be much cheaper, if they stole it. Said he knew all about engine work, and knew there were only two ways of cheapening it. Either leave off some of the work, or cut down the men's pay. Said the engine wasn't more than half made now, and that the men would burn the shop, if they were cut another cent. They were working like laborers, and getting about half the pay they had two years before. The married men had gone to corn bread, and the single men had taken to cheap, low boarding houses. The best men had left the shop, and some had quit the trade. It cost five hundred and ten dollars to put an engine in the wareroom, and others are selling the same engine for five hundred. I defy any man to go into the shop and get that ten dollars off the cost without a riot.

* * * * These earnest co-workers were at their wit's ends. Their machine lives had been pleasant. Nice, well-paid men, and living profits on work had been their experience. Now, there was no profit, and there was a constant, bitter antagonism between shop and men. It all came from these engines, this "manufacturing scheme." Pete suggested, that as they had not yet fairly started in the business, that they drop it and work on these engines as usual, building only when they got a decent order. This meant to discharge half the men, but it was decided on to take place at the end of the month.

* * * * Next week a man walked into Pete & Cady's office. He didn't have a roll of blue overalls, with a hammer, a square, and two pair of calipers wrapped up in it, under his arm. He had on nice boots, and nice clothes, and a white shirt, which would do credit to a lobbyist. He wore a plug hat. He looked smart and starchy, and had the manner and approach of a business man. He was not timid or impulsive. This clean looking chap actually asked Pete & Cady if they needed any machinists; and Pete & Cady told this clean looking chap "No." Then conversation commenced. The chap proved to be a Yankee, and the Yankeest kind of a Yank at that. He told where he had been engaged down East; worked in such a shop; foreman in such a shop; contractor in such a shop. Said he had come West to stay. Had sold his house, and had brought his money with him.

Pete smiled. The machinist had brought his money with him. Pete wanted to ask how freights were, but didn't.

* * * * Cady had heard a new word drop from this Yankee. What did he mean by saying he was a "contractor" in Summit's shop? Yankee explained what a contractor was. He takes the job from the owners of the shop for so much money, and goes into the shop and sees it executed.

* * * * Pete, smiling, remarked that it would be a good joke on the little engine business to try and get a contractor's profit out of it, when the men and the shop were both starving in trying to sell the engines at cost.

* * * * The Yankee's name was Doolittle, and he was business. In an hour he had pumped the firm dry; found out their history and present troubles with little engines, and, at the end of two hours, he had their permission to stand around the shop a week to see how they did things.

* * * * At the end of the week, Doolittle tackled the firm. Said he had leased a house for a year, got his wife and babies fixed, had twelve thousand dollars in bonds in the Rhino National Bank, and now he wanted to go to work. The firm smiled. Doolittle opened up this way: "These engines cost you five hundred and ten dollars. They are a bad job, and you ought to be ashamed of them. I never associated with steam engines, but I know all about machine work. You *must* sell these engines for five hundred to sell any. If you can sell for four-fifty, you can probably sell all you want to, according to your talk. To sell at four-fifty, they must not cost over four hundred. Your men are making about a dollar a day at hard work. You don't know what to do. Well, *I do.* If you will furnish stock at the prices you have mentioned, I will contract to deliver you a hundred engines at four hundred dollars each, better built, in every way, than those you build; and I will give your own Rhino bank as security for the fulfillment of the contract. I'll go at it right away, and furnish engines as fast as you can sell."

* * * * The firm dropped its jaw in amazement at this man's cheek. Cady, who was of an elastic nature, moved to the new conditions, unfolded. He worked on the stolid Pete, and a lawyer drew the contracts inside of three hours.

* * * * There was a Yankee "contractor" inside of Pete & Cady's shop.

* * * * Notice is served on the engine gang, and Doolittle sails in. The engine work is in his hands; the men are his. He pays them—there are twenty men. He stops every man of them and sets them at work on tools, fixtures, jigs, &c., &c., and keeps them there for a month.

* * * * Now he picks out Walter and asks him how much he got a piece for the cross heads. Walter says: "Four dollars." Doolittle says: "You must now make them for one dollar." Walter squeals and brings out his time book, showing that he only made a dollar and a quarter a day at four dollars. Doolittle dries him up by guaranteeing him a rate greater than a dollar and a quarter. Walter goes at it, and makes two dollars a day without hard work. Doolittle goes through every piece, and cuts the price down and the men's earnings up, in this proportion, all through the engine.

* * * * Pete & Cady soon became aware of the fact, that their engines were well made and interchangeable; that they were enabled to enter the market and sell them largely at a profit; that every man working on them got nearly twice the pay he did under the old plan; and that this starchy Yankee was making money out of his suicidal contract. The whole thing looked paradoxical.

* * * * Pete & Cady were happy in their mystery. They opened out into new lines of manufacture, or intended to, rather. Doolittle held a contract for a thousand engines to be delivered as wanted, and the whole thing moved swimmingly. Neither of the firm had yet solved the problem of "what was the contractor's office?" They wanted Doolittle to go into partnership. He wouldn't do it. They proposed to contract a thousand corn planters to him. He wouldn't do it. Said he would send down East and get them a contractor.

* * * * Doolittle's offer to send for another contractor to take the corn planters threw light on the whole question. Cady was the first to see the point. Pete was tied to the training of his art and was'nt much of a man to see things. Cady said: "Pete, I see it all. We have a skilled supervisor over twenty men. He is a superintendent getting big pay. We would think we were going to the dogs, if we paid a full superintendent the money, as salary, which Doolittle gets as profit. When you attended to the engine business, you spread yourself thinly over the whole shop, and depended on the wits of the men to execute your desires. You didn't pay the men for wit, but only for skill and force. Doolittle directs every stroke made by his few men. He furnishes the talent and asks force only of them.

(*Continued on Page 7.*)

The Application and Power of Belts.

BY FRANK C. SMITH, M. E.

In putting up a quarter twist belt the following points must be looked after: The pulleys must be far enough apart to allow of an easy twist in the belt. The side of the driving pulley giving off the belt must come on a center line, as *a*, *b*, of the one receiving it, as shown in Fig. 1. The center line *C*, Fig. 2, of driving pulley *B*, must be on a line with the side of the receiving pulley; that is on that side of the receiving pulley from which the belt runs. In transmitting motion from one shaft to another running at right angles to it, the "idlers" or "corner

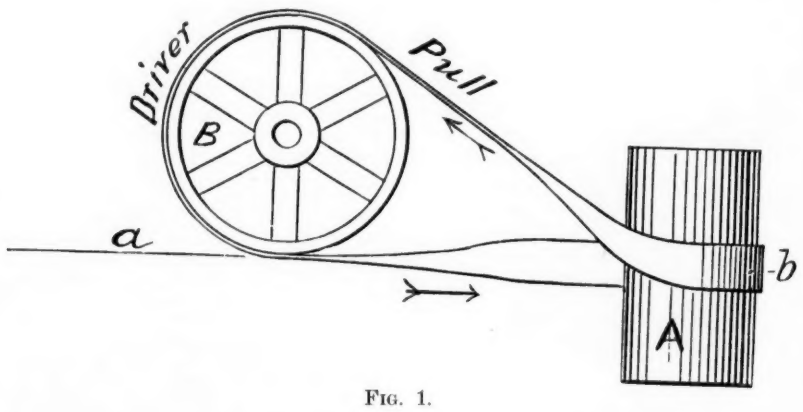


FIG. 1.

pulleys" *C*, Fig. 3, must have their peripheries coincide with the center lines of the pulleys, as *A*, *B* in the plan view and in the elevation, Fig. 4; the center lines of the idlers must coincide with the perpendicular centers of the pulleys *A*, *B*, as shown; either of which may be the driver. In case of a difference in size between *A* and *B*, the faces of the "idlers" must be increased to accommodate the angle of the belt. Wooden pulleys when the size of the pulley is large, are preferable to cast iron, especially when the want of a pattern of the required pulley is wanting. The rim of such pulleys is "built up" of pieces sawed for the purpose, glued and nailed, peaking joints. The arms are "built in," and at the center are "halved together;" that is, the arm *A*, Fig. 6, is received in one-third of its thickness on each side. The piece *B* has a recess two-thirds of its thick-

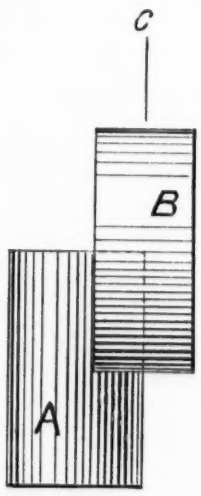


FIG. 2.

ness deep, as has also the piece *C*, in the directions shown at *A*, *B*, *C*, Fig. 7. Two cast-iron flanges previously bored out are bolted on as shown, and the face of the pulley turned off after it is mounted on the shaft. A set of "cones" with regular steps —that is with the diameters of the largest and smallest equal to the diameters of any other two pair of steps may be used if a crossed belt is run on them.

When a straight or open belt is used, the steps can be found by the following method: Knowing the diameters of the largest and smallest steps, we may draw them as shown in Fig. 5, as *A*, *C*, with the proper distance between centers; also, an elevation as *A*, *C*, Fig. 8. The length of the belt is that portion of the circumference of each step, *A*, *C*, that the belt is in contact with, plus twice *a a*.

The next thing is to find the diameter of the two middle or same sized steps *B*, *D*. By subtracting twice the distance *b*, *b* from ths length of the belt, we get the approximate circumference of either step *B*, *D*. If twice the distance *a*, *a* is greater than twice *b*, *b*, the difference must be added to the approximated circumference of *B* or *D* for the exact circumference, and if 2 times *a*, *a* is less than 2 times *b*, *b*, the difference must be taken from the approximated circumference of *B* or *D* for the exact circumference, the diameter of which is laid down as *D*, Fig 8. The arc of a circle cutting the three points *a*, *b*, *c*, will give the centers of the other steps which may be drawn. That part of the circumference embraced by the belt may be found by the following rule: multiply the number of degrees in the arc (part of circumference embraced by the belt) by 3.1416 times the radius and divide by 180. The number of degrees can be found by a quadrant.

Fig. 9 shows a reliable plan for lacing a belt. The lace is thrust down through 1, up through 2, crosses the back of the belt to 3, down through it, and up through 4, etc. The belt may, when laced across, be laced back again, by going from 10 to 7, up through 8, and down 5, etc., making a firm and lasting joint, which keeps the belt ends flush with each other, the lacing running parallel with the belt on the pulley side.

Following are some useful rules for ascertaining the diameter of pulleys: Suppose you wish to run a machine at a given speed from a pulley on a line shaft. The revolutions of the line shaft and diameter of the pulley on it being known, multiply them together, and divide this product by the number of revolutions the machine to be driven is desired to make; the quotient equals the size of the pulley to be placed on the machine. If there had been a pulley on it, and you wished to ascertain the number of revolutions it would have made, you would have divided by the diameter of the pulley instead of the revolutions. For exact work, from 5 to 15 per cent. more speed than is wanted should be calculated upon, owing to the slip of the belt.

Belts run over a leather-covered pulley, with the hair side next to the pulley will give the best results. The speed of a belt for exactness should be calculated by adding the thickness of the belt to the diameter of the pulley it runs over; this gives the center of this belt as the diameter of the pulley.

Belts should have an occasional dressing of castor oil. The writer remembers a 30-inch belt that was immersed in castor oil nearly thirty years ago, and which has never been off of the original pulleys but once since, and only then on account of the removal of the entire shop and engine to new quarters. The writer refers to leather belts, as it alone is fit to make a belt of. Rubber belts should not be tolerated. They work well enough on the start, but a little slipping ruins them. Renting power by rules based on the width of a belt, conveys about as correct an impression of the amount used, as the experience "as big as a piece of chalk" does the size of the article compared. For instance, 1,100 feet per minute by a one-inch belt, it is stated, will transmit one h. p; 700 feet per minute by a one-inch belt, it is also stated, will transmit one h. p. Both may be right; but the conditions on which these two rules were based were wide apart. There is a variation of fifty per cent. between belts and pulleys in transmitting power. The indicator is the only means by which power can be correctly rented. Pulleys may be "crowned" $\frac{3}{16}$ of an inch to the foot in width. The slack side of the belt should be, when possible, on the top side, as it increases the "hug" of the belt.

To ascertain the correct length of belt to be taken out or put in when pulleys are changed, multiply the difference in the diameters of the pulleys by one-half; the product equals the amount necessary. From 65 to 100 pounds per inch in width is the correct amount to be transmitted by a belt $\frac{3}{16}$" thick. The following rule has been used for some time by the writer for the width of belts in inches with satisfaction: multiply the h. p. to be transmitted by 5,400, and divide this product by the velocity in feet per minute; multiplied by diameter of smaller pulley in feet. This rule will be found to give a belt wide enough to do the work without slipping or tearing out.

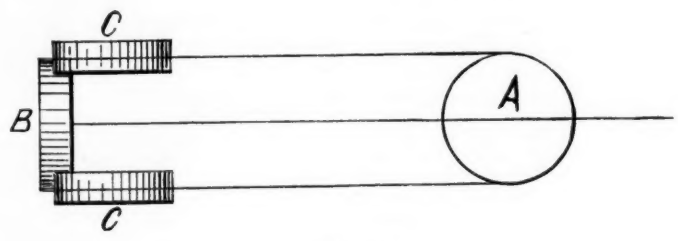


FIG. 4.

Advantages of High-Speed Engines.

No. 10.

BY CHARLES T. PORTER.

We saw in our last article that at moderate piston speeds the alternate inertia and momentum of the reciprocating parts of an engine are overcome by a moderate amount of force, and so their effect in equalizing the motion, though important, is far less than it ought to be for the attainment of the best results. The examination of the subject showed why, when a close approximation to uniform rotation is desired in engines of the class under consideration, it is found necessary to employ such large and heavy fly wheels.

violent impulses is transformed into a near approximation to uniform pressure.

Engineers sometimes refuse to give consideration to this new-fangled doctrine, on the ground that it is altogether ideal, abstract and of no *practical* account. Well, this action is exactly as abstract as that of the fly wheel, for it is precisely the same. The latter regulates motion by alternately absorbing the force which accelerates it, and imparting that which it loses when retarded. The action of the reciprocating parts of the engine is the same in its nature, and hardly less important. Indeed, it has this remarkable advantage *over* that of the fly wheel, that whereas it is necessary, if we desire a close approach to uniform motion, that the fly wheel be called upon to act as little as possible, since it can only do so by changes in its speed, and so is an imperfect regulator of motion, the reciprocating parts of the engine, on each stroke, exert their entire efficiency, absorbing *all* the force required to impart to them during the first half of the stroke their full speed from a state of rest, and during the last half imparting *all* their momentum in coming again to a state of rest; and they do this without involving any variation of the crank from uniform rotation.

It is not necessary that any consideration be paid to the relative proportions in which weight and speed are combined in giving this action. The product of the two, $m\ v^2$, is alone to be considered. It will be found, however, that speed becomes a very important factor; that, in fact, it is only at speeds considerably above those hitherto generally in use in stationary engines, that, even with heavy reciprocating parts, this important action, in its full development, becomes attainable. On the other hand, at very rapid speeds care must be taken to lighten the reciprocating parts, sometimes extremely, or this action becomes excessive, and so an in-

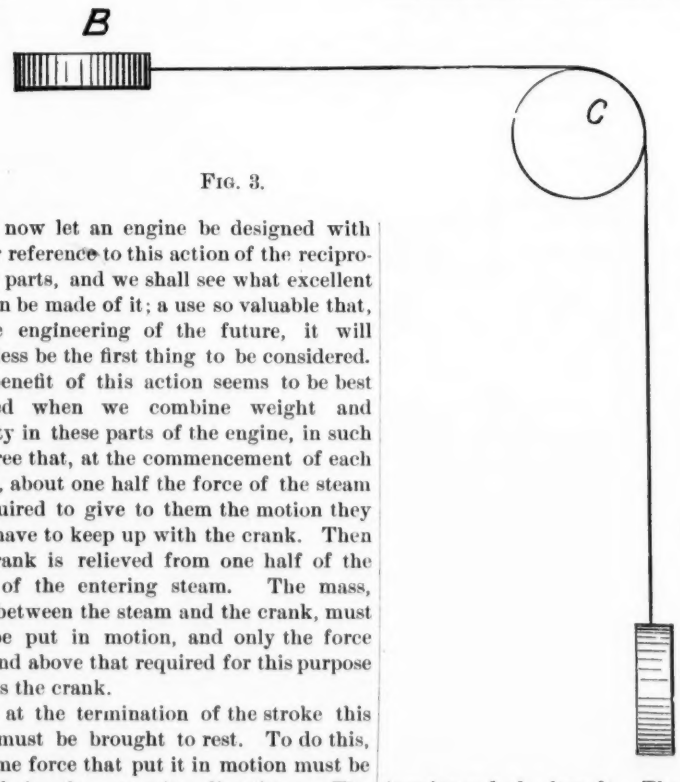


FIG. 3.

But now let an engine be designed with proper reference to this action of the reciprocating parts, and we shall see what excellent use can be made of it; a use so valuable that, in the engineering of the future, it will doubtless be the first thing to be considered. The benefit of this action seems to be best realized when we combine weight and velocity in these parts of the engine, in such a degree that, at the commencement of each stroke, about one half the force of the steam is required to give to them the motion they must have to keep up with the crank. Then the crank is relieved from one half of the force of the entering steam. The mass, lying between the steam and the crank, must first be put in motion, and only the force over and above that required for this purpose reaches the crank.

But at the termination of the stroke this mass must be brought to rest. To do this, the same force that put it in motion must be exerted in the opposite direction. The resistance of the crank, or of the fly wheel and machinery through the crank, furnishes this retarding force. In other words, the reciprocating parts give out their momentum, through the crank, to the fly wheel and machinery.

And so we have a change effected that seems little short of magical; a force averaging one-fourth of the entire steam pressure is taken from the first half, and added to the last half of the stroke, and a succession of jury instead of a benefit. The readiness and certainty with which our little formula enables the desired result to be reached in every case, renders its use not only most satisfactory, but really fascinating.

I will illustrate this by examples, the first normal, the last two exceptional, from my own practice. An engine, 18" bore by 30" stroke, is to make 165 revolutions per minute; what must be the aggregate weight of the piston, rod, cross-head, and connecting rod, in order that, as the mean of the two

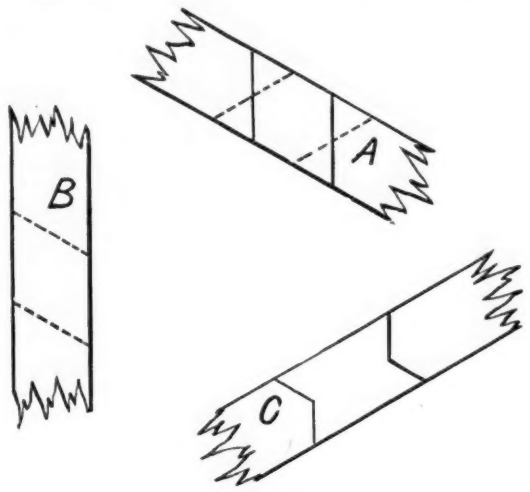


FIG. 7.

centers, they shall require, at the commencement of each stroke, a force equal to 40 lbs. on each square inch of piston area, assumed to be one-half the steam pressure, to impart to them their velocity?

The accelerating force will be ($165^2 \times 1.25 \times .000341$), 11.6 times the weight of these parts.

The pressure to be absorbed will be $254.5 \times 40 = 10{,}180$ lbs.; and

The weight required will be $10{,}180 \div 11.6 = 895$ lbs.

Sometimes we cannot have the speed we would. What must this weight be in case of an engine, 40″ bore by 48″ stroke, making only 90 revolutions per minute, to absorb 30 lbs. pressure on the square inch at the commencement of each stroke?

$90^2 \times 2 \times .000341 = 5.524$;

$1256.6 \times 30 = 37{,}700$; and

The weight required is $37{,}700 \div 5.524 = 6{,}830$ lbs.

Sometimes an exceptionally high speed is demanded. What must be this weight in case of an engine, 11½″ bore by 20″ stroke, making 350 revolutions per minute, to absorb 30 lbs. pressure, or same as in last case?

$350^2 \times .8333 \times .000341 = 34.8$;

$103.86 \times 30 = 3{,}115.8$; and

$3{,}115.8 \div 34.8 = 91.6$ lbs., the weight required.

This it is not practicable to bring the weight down to, and, instead of half the pressure of the steam, the whole of it will be needed to furnish the initial accelerating force, and if the pressure falls a little, even this will not answer, and the fly-wheel must help to start the piston on each center; but at the great speed this cannot sensibly affect the steadiness of the motion.

FIG. 6.

New Armor Plates.

Composite (or steel-faced) armor plates are rolled at one of the leading Sheffield works in the following manner: To the iron armor plate to be faced, is attached a frame of iron bars. This frame is capable of holding a quantity of steel, about half the thickness of the iron plate, and, when fixed, is placed in the furnace and brought to a welding heat. On withdrawal, the frame is filled with Bessemer steel, and after cooling, is reheated and rolled in the usual manner. The finished plate is iron on the back, while the face is of steel.

To-day American tin ware is sold in Birmingham, although the tin comes from Cornwall, and pays freight here and back, besides the duties on it. American baby-rattles, too, are shipped to England; and little brass and iron wheels, pinions, and such things, are sent to the old town of Nuremberg, Germany—the center of the toy trade of the world—to be made up into toys, to be put together by the women and children of Germany, who have not yet been able to make iron and steel and steam to do the work of human hands, as have the inventors of the United States.—*Boston Com. Bulletin.*

Preventing Railway Holocausts.

In 1869, the Legislature of the State of Ohio passed a law intended "to protect more effectually the lives of railroad passengers from danger by fire." The act provides that each railroad company in the State shall heat its passenger cars by a heating apparatus, so constructed that the fire in it will be immediately extinguished whenever the cars are thrown from the track and overturned, and also that three disinterested persons shall determine as to the price of a heater, such as is offered for sale. The penalty for a violation of this law is a forfeiture of not more than $500, nor less than $100, which may be recovered on action before a justice of the peace in any county, one-half the penalty to go to the informer, the other half to the State for the benefit of the common schools. Under this law a large number of suits have been brought against the Baltimore & Ohio, and the Pittsburgh, Fort Wayne & Chicago roads. The object is to compel these companies to use certain patented devices; and the companies themselves probably desire a test case. Whatever may be thought of the efficiency of legislation of this kind, and its tendency to aid certain patentees, the necessity for the more general adoption of improved methods of heating, looking both to comfort and safety, is apparent. Mr. Adams, in his recent work, justly denounces the barbarous method in general use, which is the same as that first employed on railroads. Legislation should only be resorted to when everything else fails—but there should be no more holocausts of railway passengers.—*Railway Review.*

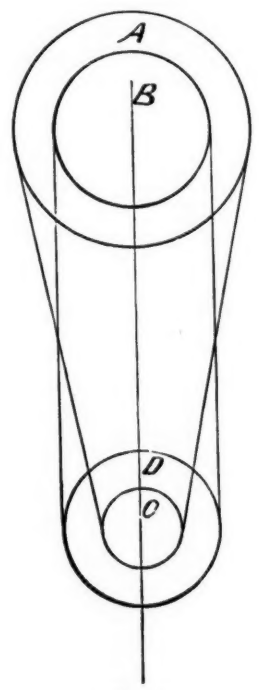


FIG. 5.

Gleanings from the Foreign Press.

We take the following instructions to firemen, issued by the Boiler Insurance and Steam Power Company, Limited, from *The Universal Engineer:*

Water gauges should be blown out frequently during the day, and the glasses and passages to the gauges kept clean. More accidents are due to inattention to water gauges than to all other causes put together.

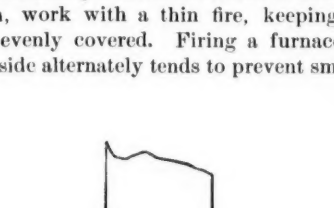


FIG. 8.

Safety valves should be tried at least once a day, to make sure that they will act freely. Overloading or neglect of these valves tends to the most disastrous results, and cannot be too carefully guarded against.

Pressure gauges, where fitted with cocks, should be tried occasionally by shutting off the steam and letting the pointer run back to zero. For this purpose the cock to the gauge should be arranged to open to the atmosphere when shut off from the boiler.

Blow-off cocks should be taken apart, examined and greased when the boiler is cleaned. Make certain that no water is escaping from the blow-off when the cock is supposed to be closed.

Check valves, or self-acting feed valves, should be taken out and examined when the boiler is cleaned. Satisfy yourself frequently that the valve is acting when the feed pump is at work.

Fusible plugs should be examined when the boiler is cleaned, and carefully scraped clean on both the water and fire sides. If this is not done, the plug will not act.

To save coal, keep the boiler clean inside and outside. If there is a plentiful supply of steam, keep a thick fire; but, if short of steam, work with a thin fire, keeping the bars evenly covered. Firing a furnace on each side alternately tends to prevent smoke.

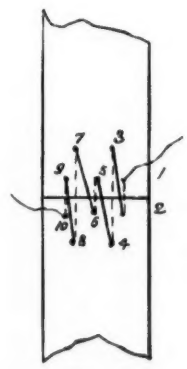


FIG. 9.

To preserve the boiler raise the steam slowly. Never light fires till the water shows in the gauge glass. Never empty under pressure, but allow the boiler and brickwork to cool before running the water off. Clean the boiler inside regularly once a month; oftener if the water be bad. Clean all flues once a month, stop any leakages, and get rid of any damp in the seatings or covering. Examine especially plates subject to the direct action of fire, the underside of the boiler, and any parts in contact with the brickwork, or with copper or brass, where water is present. If not required for some time, and it is impracticable to empty and thoroughly dry it, fill the boiler quite full with water and put in a quantity of common washing soda.

Should the water get too low, draw fires at once, as a rule; but if the fire is very heavy, or if the furnace crown appears to be red-hot, it is best to smother the fire with wet ashes, wet slack, or any earth that may be at hand. The dampers may then be closed. If the engine is running, or the feed pumps delivering into the boiler, do not stop them; but, if not working, do not start them, and do not attempt to blow off the steam until the fire is out and the over-heated plates have cooled.

Railway Coach Lamp Platform.

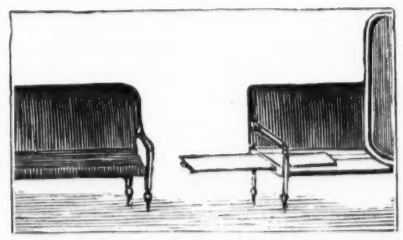
A few days since our attention was directed to an ingenious device which has lately been attached to the seats of the passenger coaches of the Morris and Essex Division of the D. L. & W. R. R., and which we illustrate herewith. It consists of a board which passes through the end, and is fitted into slides under the seat, as shown, one of these being located directly under each lamp in the coach. The object of this device is to furnish a strong, reliable, and durable support for the brakeman while engaged in cleaning and lighting the lamps. When not in use, the board is pushed under the seat; when required for use, it is drawn out by means of a handle. The end rests, when in use, upon the end of the seat opposite.

Nearly all persons who are accustomed to travel upon railroads know, to their disgust, the nuisances attending the lighting of lamps in passenger coaches. The brakeman usually

comes along and proceeds without a word to climb with his muddy boots upon the arm of the seat, in order to reach the lamp, and after performing this duty, walks unconcernedly away, leaving the arm of the seat daubed with oil or mud, which the unwary passenger may clean off at his leisure.

Ladies are frequently the greatest sufferers from this nuisance, as the brakeman, whether rude or gentlemanly (and there are brakemen who are gentlemanly), if compelled to stand upon either the arm or cushion of the seat, must necessarily damage, more or less seriously, the dress of the lady passenger sitting near.

In case portable steps are provided for this purpose, such steps are liable to be lost or



misplaced, in carrying from car. At best, such contrivances are insecure and clumsy, subjecting the uneasy passenger to risk of having brakeman, oil, lamp and all, tumbled incontinently about his or her ears, by a sudden jerk of the train in stopping or passing a curve. Many cars are sent to repair shops, and their usefulness, for the time being, lost to the company and its patrons, that need not have been withdrawn from the service, had this simple and inexpensive device been adopted as part of their furniture.

The inventor is Mr. F. W. Coolbaugh, train dispatcher of the D. L. & W. R. R., Hoboken, N. J.

TO CLOUD METAL WORK.—Metal work may be clouded by putting a piece of fine emery paper under the thumb or finger and working it over a surface of the metal with a spiral motion. A very fine oil-stone may also be used.

Spacing of Rivet Holes for Boiler Joints.

BY W. BARNET LE VAN.

The greatest strength of any structure is only equal to that of its weakest part. In steam boilers this has proven to be the fact; namely, that the joints or seams are generally the weakest part.

On comparing the strength of plates with their riveted joints, it will be necessary to examine the rivet holes with the section of the plates themselves. It is perfectly obvious, that in perforating a line of holes along the edge of a plate, we must reduce its strength. This is best illustrated in the ordinary postage-stamp; the sheets are pierced with small holes around each stamp, so that they may be easily separated. This also illustrates, practically, the cause of a great many boiler explosions, which are due to the weakening of the plate by punching the rivet holes too close together.

The plate so perforated will be to the plate itself, nearly as the areas of their respective sections, with a small deduction for the irregularities of the pressure of the rivets upon the plates; or, in other words, the joint will be reduced in strength somewhat more than in the ratio of its section through that line to the solid section of the plate. It is evident that the rivets cannot add to the strength of the plates, their object being to keep the two surfaces of the lap in contact. When this is taken into account, it cannot but be great deterioration of strength at the joints of the greatest importance, that in structures subjected to such great strains as boilers, the strongest method of riveting should be adopted.

A riveted joint gives way, either by shearing off the rivets in the middle of their length or by tearing through one of the plates in the line of the rivets. In a perfect joint, the rivets should be on the point of shearing, just as the plates were about to tear; but in practice, the rivets are usually in excess of the plate in strength.

The space between rivet holes should be as far apart as it is practicable to calk the seams that they shall be perfectly water and steam tight.

The writer has adopted the following tables in his practice for spacing rivets, which give the value of the plate between rivets, and of the rivets; also the percentage of the solid plate remaining when the joint is finished.

The value of the plate after it is punched is taken at 36,000 pounds per square inch of section.

The value of the rivets to resist shearing is taken at 50,000 pounds per square inch of section.

DOUBLE RIVETED JOINTS.

The advantage of double riveted joints is that they are stronger than single riveted joints. This additional strength is derived from spacing the rivet holes further apart leaving more metal of the plate between the rivets. The rivets are placed in two rows, and zigzag or staggering to one another. The proportion of thickness of the plates to the diameter of the rivets, and spacing of the same, should be such that the shearing strength of the rivets be equal to the tearing strength of the plate.

The table below gives the practice of a large number of high pressure boilers working up to 150 pounds per square inch, with proportions of diameter of rivet and thickness of plates as there given. The diameter of rivet is taken as the average diameter of the hole, and not the net size of the shank of the rivet.

The writer in 1870 ordered two boilers and specified the riveting to be as indicated by the table below, which for plates $\frac{5}{16}$ inch thick, was as follows: Diameter of rivets $\frac{5}{8}$ inch; space between rivet centers, 2 inches; breadth of lap $2\frac{1}{8}$ inches. For the double riveted joints see sketch herewith.

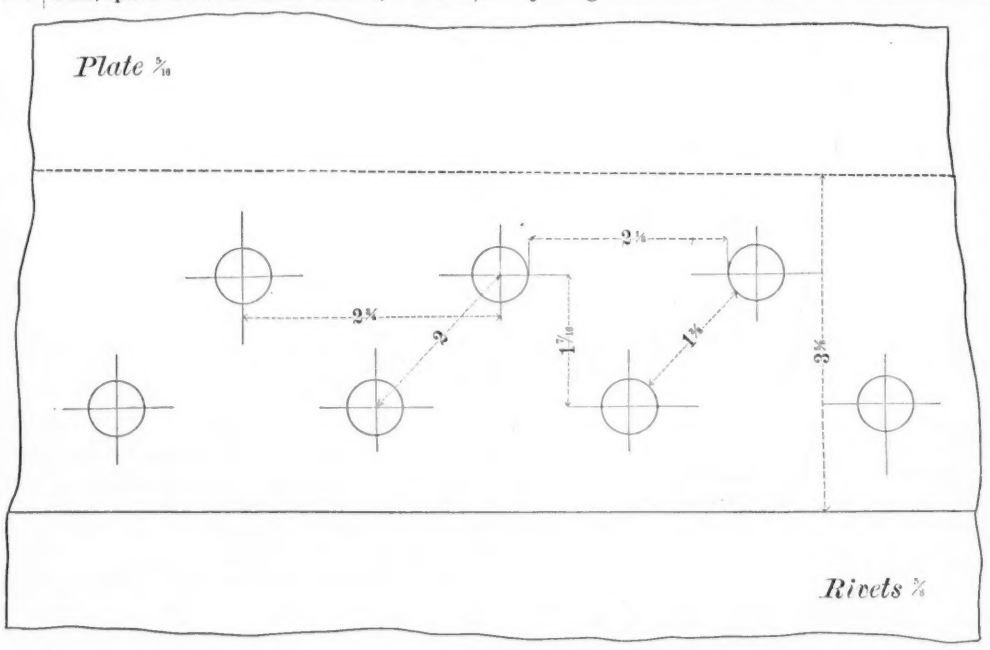
The lap was to be $3\frac{5}{8}$ inches; the space in line between rivets, $2\frac{3}{4}$ inches; the space diagonally, 2 inches; distance apart between lines $1\frac{7}{16}$ inches.

One of our largest and best boiler-makers, who proposed to build them, objected to the spacing of the rivets, on the ground that it would be impossible to calk the joints tight with the rivets so far apart.

The matter was referred back to me for modification, but, after a consultation with their master boiler-maker, the firm concluded to proceed to build them, as per specification, I assuring them that there would be no difficulty in making the joints tight, and that I would relieve them of responsibility in the matter, in case of leakage.

The boilers were built and proved perfectly tight under a water pressure of 150 pounds per square inch, and a steam pressue of 100 pounds. The boilers were erected the same year, and are still in use, under a working pressure of 75 pounds per square inch.

Up to the present writing, I have had a large number of boilers built, with the spacing as per table of thicknesses from $\frac{1}{4}$ to $\frac{3}{8}$ inches, and all of them give perfect satisfaction.



PROPORTION OF SINGLE RIVETED LAP JOINTS.

Thickness of plates in frac. of an in. t	RIVETS. Diameter in inches. d	RIVETS. Length in inches. l	Area in square inches. a	DIS. BTW'N RIVETS. Centers in inches. c	DIS. BTW'N RIVETS. Plate in inches. s	Breadth of lap in inches. b	Value of plates to resist tearing. $v = s \times t \times 36{,}000$.	Value of rivets to resist shearing. $v' = a \times 50{,}000$.	Per cent. of area of solid plate. $P = \frac{c-d}{c}$
1/4	3/4	1/2	0.1104	1	1/4	1 1/8	2.812	5.520	62.5
3/16	3/4	1/2	0.1104	1	1/4	1 1/8	4.218	5.520	62.6
5/16	7/8	1/2	0.1963	1 1/16	5/16	1 1/4	10.125	9.815	69
3/8	1	1/2	0.3067	2	3/8	1 3/8	15.468	15.335	68.7
7/16	1	5/8	0.4417	2 3/16	7/16	1 7/16	21.930	22.085	68.4
1/2	1	5/8	0.5184	2 9/16	1/2	1 1/2	27.560	25.920	68.2
9/16	1	5/8	0.6013	2 3/4	9/16	1 5/8	33.750	30.065	69.5
5/8	1 1/16	5/8	0.6902	3	5/8	1 3/4	40.030	34.510	68.7
3/4	1 1/16	5/8	0.7854	3 1/16	2	2	45.000	39.270	67.3

PROPORTIONS OF DOUBLE RIVETED LAP JOINTS WITH PUNCHED HOLES.

Thickness of plates. In fract'n of an in. t	Thickness of plates. In dec. of an inch. t	Rivets. Diameter in inches d	Rivets. Length in inches l	Rivets. Area in sq'r in. a	Distance betw'n rivets. Centers in inches c	Distance betw'n rivets. Plate in inches s	Diagonal dis. betw'n rivets. Centers in inches c	Diagonal dis. betw'n rivets. Plates in inches s	Lap. Breadth in inches b	Value of plate. $v = s \times t \times 36{,}000$.	Value of rivets. Resist shearing in sq. in. $v' = 2a \times 50{,}000$.	Per cent. of area of s'ld plate $P = \frac{c-d}{c}$
1-8	0.125	3-8	5-8	0.1104	9-16	1 1-4	1	5-8	2 1-4	5.625	11.040	77.
3-16	0.1875	7-16	7-8	0.1104	9-16	1 1-4	1	5-8	2 1-4	8.437	11.040	77.
1-4	0.25	1-2	1 1-8	0.1963	2	1 1-2	1 5-8	1 1-8	3 1-4	20.700	19.630	75.
5-16	0.3125	5-8	1 3-8	0.3067	2 3-4	2 1-8	2	1 3-8	3 5-8	24.446	30.610	77.6
3-8	0.375	3-4	1 3-4	0.4417	3 3-8	2 5-8	2 3-8	1 5-8	3 7-8	35.437	44.170	77.7
7-16	0.4375	13-16	2 1-8	0.5184	3 5-8	2 13-16	2 9-16	1 3-4	4 1-8	44.305	51.840	77.
1-2	0.5	7-8	2 1-4	0.6013	3 7-8	3	2 3-4	1 15-16	4 3-4	54.000	60.130	77.4
9-16	0.5625	15-16	2 1-2	0.6902	4 1-16	3 1-16	3 1-16	2	5	62.114	69.029	76.5
5-8	0.625	one	2 3-4	0.7854	4 1-4	3 1-4	3 1-4	2	5 1-8	73.125	78.540	77.

NOTATION OF LETTERS.

a = Area of rivet in square inches.
t = Thickness of plate in inches.
d = Diameter of rivet in inches.
l = Length of rivet in inches.
c = Centre to centre of rivet.
s = Length of space between rivet holes.
b = Breadth of lap in inches.
v = Value of plates to resist tearing.
v' = Value of rivets to resist shearing.
p = Per centage of area of solid plate.

BRAZING CAST IRON.—There are two ways of joining cast iron. 1. Fit the broken pieces exactly together in moulding sand, and pour melted iron over the parts to be joined until they are sufficiently heated to unite. When cold chip off the superfluous metal, and you will have a joint scarcely to be detected. 2. Well tin the parts to be joined, fit together in sand as above, and pour melted brass over them.

Letters from Practical Men.

TEETH AND DIAMETER OF GEAR WHEELS.

Editor American Machinist:

As there are a great many machinists that do not know how to find the diameter of a gear-wheel for any number of teeth, or how to find the right number of teeth for a gear of any diameter of a certain pitch, I give herewith a table of diameter pitches, as they are now generally used instead of circumference pitch, except in gears with teeth larger than 1″ or 3″ pitch.

Diameter pitch.	Circumference pitch in Dec. of inches.	Circumference pitch in inches to nearest $\frac{1}{32}$.
3 inch	1.047	1
4 "	.785	$\frac{25}{32}$
5 "	.628	$\frac{5}{8}$
6 "	.524	$\frac{1}{2}$
7 "	.449	$\frac{7}{16}$
8 "	.393	$\frac{3}{8}$
9 "	.349	
10 "	.314	$\frac{5}{16}$
12 "	.262	$\frac{1}{4}$
14 "	.224	
16 "	.196	$\frac{3}{16}$
20 "	.157	$\frac{1}{8}$

A single example will render the mode of using the table plain. Suppose the diameter of the pitch circle of a wheel is 18 inches, and that it is to be cut to a twelve-pitch (in the first column of the table) all that is necessary is, to multiply 18 inches by 12, which gives 216 for the number of teeth in the wheel: the circular pitch of such a wheel is accurately .262 or nearly $\frac{1}{4}$ of an inch. Had it been required to find the diameter of a twelve-pitch wheel of 216 teeth we would divide the number of teeth by the given pitch: example $\frac{216}{12} = 18$ inches diameter of pitch circle. And add *two* of the pitch which in this case would make the diameter of the gear $18\frac{2}{12}$ inches.

T. W. R. MCCABE.
No. 601 N. 18th St., Philadelphia.

FITTING UP ENGINE SIDE BRASSES.

Editor American Machinist:

Much has been written about the efficiency of the Steam Engine. One's whole attention is drawn to the cylinder into which steam is admitted, perhaps, by peculiar valves and valve gear; but seldom is anything said about other parts, quite as vital to insure a good working engine.

I wish to call attention to one feature, which has often been found defective; that is the manner in which the chucks or side brasses of the fly shaft journal next the crank are fitted up; also the manner n which they are kept up to their work. Some attention is usually paid to the bottom brass to see that it beds or fits well to the place assigned it at the bottom of the pedestal; but the side brasses, beyond the boring of the side intended to go next the shaft, receive no attention whatever. They are just as they came from the founder's hands; they are dropped into their places, with a plate of iron or steel behind them, and the set screws brought up against the plates. The consequence is that often the said side brasses work against the end of the set screws as if they were a pair of hinges, and do what one will, or may be able to do under the circumstances in which he is placed, that part of the engine is unsatisfactory to say the least of it. I saw one fly shaft that had a flat place on the journal from the continual hammerings, as it were, at the turning of each center, and another where the set screws worked themselves clear through a steel plate and the brasses, from this cause.

If the back of brasses were made as true to the jaws of the pedestal as the opposite side is to the shaft, and the space between the brasses and the jaw of the pedestal made of equal width from bottom to top and from end to end, suitable pieces of iron or steel could be used as packing or filling, and there would be little use for set screws. In my way of thinking four set screws to each brass, two near the top and two near the bottom, would prove far more satisfactory than the two usually found. The plan might be objected to on account of the extra work, or cost of doing so, but I feel very sure neither the owners nor the men who run such engines would ever think about it. If done as first indicated there would be no necessity for set screws in engines not required for use a portion of each day or week; but where their use is required continuously they should be added. It would be best to apply it to all engines sent out of the shop, as there is no telling "to what base uses they may be put."

WILLIAM J. WILLIAMS.
West Conshohocken, Pa.

WANTED—A first-class engineer, one who thoroughly understands the Brown engine; must be a first-class machinist, with considerable ingenuity, able to do a fair job at the forge, and capable of taking charge, and repairing the machinery, piping, etc., of a large manufactory; only those who are fully competent to do all this advertisement calls for need address, with references, "Brown Engine."

Mr. Editor:

The party who penned the above, no doubt, slapped his knee with a self-satisfied air, and thought he had written a "stunner." We will allow that he is not a "Wyckoff" in the matter of writing advertisements, if he is in the management of his large manufactory.

Imagine, if you can, the flattering visions that rise before him, of his model engineer and general factotum, who, he expects, will flock by the hundred on the appearance of his sagaciously-worded invitation, and to whom, for all therein contained, he is willing, in the magnanimity of his heart, to pay the sum of ——dollars per week, more or less (probably less), and then look at the other side. How many parties that fit the above do you believe are out of employment to-day? I will venture to say, not one; such a man, unless afflicted with a bad habit, seldom is reduced to the necessity of answering such an advertisement. He is a jewel, a diamond of the first water, and needs no new setting, such as offered by the by-no-means tempting words. The "Brown Engine" is a good one, no doubt, but, where there is one engineer who thoroughly understands the "Brown," there are probably one hundred who never saw one; nor is it essential that a first-class engineer should ever have seen this particular engine to be able to run it successfully. A first-class engineer will adapt himself to any engine, and a first-class machinist will repair one as well as another.

How many assistants would be needed to enable this model engineer to run the engine, to do the machine work, to be blacksmith, to be steam fitter (and I shouldn't be surprised if he were required to do his own firing),—these all—and neglect not the least of them; five trades in one, and all for —— dollars per week?

If allowed a fireman, the latter would probably be helper at the forge and for all jobs requiring aid; think of this, and wonder not at mysterious boiler explosions.

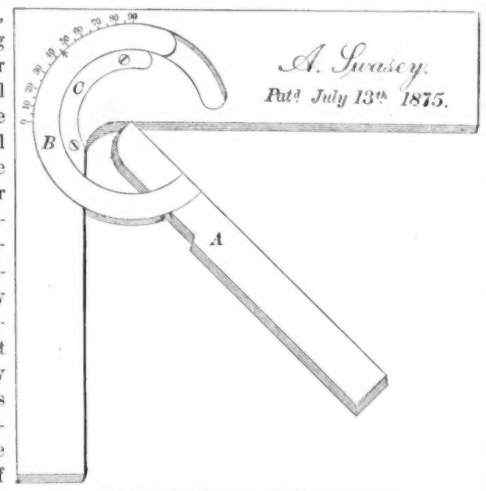
Mr. Editor, the party, who will answer this advertisement, will be the man least fitted to fulfill the requirements; the right man can only be obtained by stealing him from some more fortunate concern by liberal offers. He should command a good salary and a great deal of respect—this master of five trades!

I hope this may meet the eye of the advertiser, or of other parties who expect one poor mortal to master five trades, and perform the manual labor of all for the compensation allowed to one.—X. D., North Plymouth.

Swasey's Bevel Protractor.

The accompanying illustration represents a new instrument intended for the use of draughtsmen, machinists and surveyors. It was invented by Ambrose Swasey, at the shops of the Pratt & Whitney Co., of Hartford, Conn. First, we have a plain steel square, one-eighth of an inch thick, the two sides of which are each five inches in length. A swinging rule, or blade *A*, is attached to the square by means of a circular piece *B*, which moves in a dove-tailed slot, and may be set to move tight or loose by means of two screws and the binder *C*, depending upon the friction to hold it. The edge of the slot is marked with the different degrees, from zero up to 90°. In the illustration, each mark on the arc represents 5°, while in the regular instrument each of these degrees is marked. Both sides of the protractor presents a level face, so that it may lie flat upon the paper, and be used equally well on either side. The protractors in general use have a thumb-screw (to hold the blade), which projects from one side, in consequence of which only one side can be used.

The Swasey instrument is so arranged that any angle may be measured or drawn, whether acute or obtuse. Should the draughtsman wish to draw a line at an angle of 65° from his T square, set the zero mark on the sliding arc to that number, as indicated by the graduations, and placing the base of the square forming that angle with the swinging rule against the T square; then draw the desired angle. By simply turning the instrument one-quarter turn, round towards the right, so as to bring the other base of the square against the T square, will give an angle of 155°. If the instrument be now lifted by the right-hand corner and turned over towards the left (upside down), the angle formed will be 25°. Again, if the instrument be placed in the first position, as shown in drawing, the angle being 65°, taking hold of the left-hand corner and turning it over (upside down), will give an opposite angle of 115°. From the foregoing illustrations, the reader will understand that after drawing an angle of 60°, by turning the instrument over the same angle may be drawn but pointing in the opposite direction. The advantages of these problems may be readily understood by draughtsmen, as by simply turning the instrument, any angle, or its complement, may be drawn at once. This instrument is particularly adapted to the measurement of angles drawn upon paper or any other plane surface, as the swinging rule being the same thickness as the square, the edges of both lie even upon the paper, thus the protractor can be more accurately adjusted to the lines than if one edge were raised above the surface, as is the case with most protractors.



SWASEY'S BEVEL PROTRACTOR.

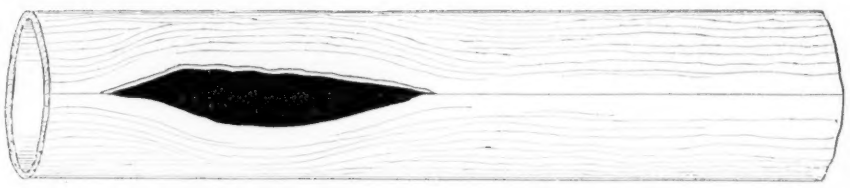
Another practical advantage in having both sides of the protractor even is, when the angles of solid bodies are to be measured, as in the case of crystals, pieces of machinery, etc., there is no difficulty in holding it firmly and squarely upon the piece to be measured, at the same time forming the angle between the swinging rule and body of the tool, open to the apex. The cross-section lines of complicated parts of machinery, where a number of angles are required to bring out the different parts distinctly, may be readily drawn by adjusting the swinging rule.

There are many other points which recommend this tool to the consideration of practical men, which may be seen at once by an examination of one of these instruments. Full particulars may be had by addressing Ambrose Swasey, at the works of the Pratt & Whitney Co., Hartford, Conn.

Explosion of a Water Tube Boiler.

Editor American Machinist:

An instance of immunity from disastrous explosion occurred recently in a steam boiler on the water-tube system as constructed by Messrs. Babcock and Wilcox of this city, under circumstances which made a severe test, to say the least. In the Brooklyn Sugar Refinery is a boiler of 400 horse power, from which, by an oversight, the feed was cut off and not noticed until the level became so low that the boiler was nearly empty and the tubes were overheated.



EXPLODED WATER TUBE IN A BOILER.

The result was that one of the tubes burst, as shown in the engraving subjoined. This was speedily repaired at a cost of fifteen dollars, and the works were running again the next day with no loss of time.

Another boiler of the same kind in the Elizabeth, N. J. jail, was subjected to a still greater ordeal. In this institution the convicts were in charge of the apparatus, and one of them started the fire as usual in the morning. After waiting an hour or so and not perceiving any signs of life in the steam gauge, this particular individual communicated his astonishment and disgust to some of the officers. Investigation disclosed the fact that there was good reason for the absence of steam, there being no water in the boiler to make it from. Also, that the blow-cock was wide open and had been so since the night before. After the syndicate had opened the furnace door and seen the red hot tubes it was thought a good idea to get some water in as quickly as possible, so they shut the blow-cock (for a wonder) and turned on the city water; the result justified their expectations; steam was made very quickly; for a moment it roared through the safety-valve with a fearsome sound, and that is all that happened, beyond the renewal of a few of the tubes in the lower course. If either of these had been fire-tube boilers it is not contrary to precedent to say that, in all probability, there would have been an opportunity for a coroner's inquest and a new jail.

EGBERT P. WATSON.

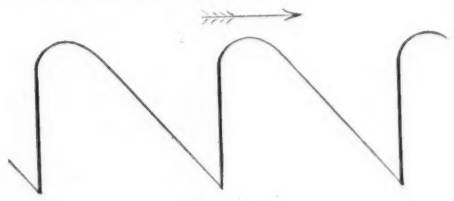


FIG. 2.

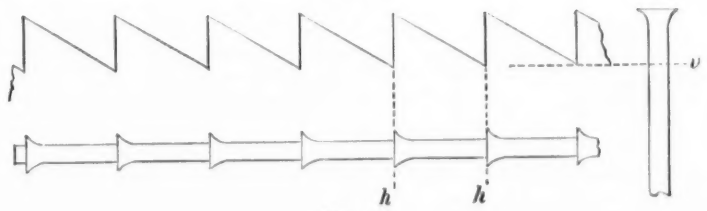


FIG. 1.

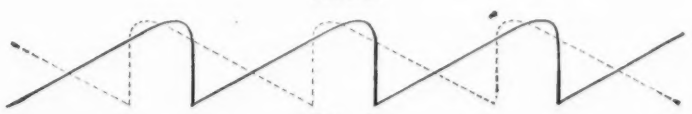


FIG. 3.

The "M" Saw Tooth.

When metal bladed saws were first made they were doubtless rudely nicked blades, such as a school boy would manufacture from a table-knife.

As tools improved the saw fell in likewise, and had regular upright V teeth, cutting in both strokes. After some time it was made with inclined V teeth cutting one way only, and this one way was the *pull*—much easier to get at with the blades then made, which were not as stiff and springy as our modern makers turn out.

Bear in mind that all the ancient saws of which we know, cut on the "pull" only, just as did the Japanese saws used at our Centennial, and which were types of all modern Asiatic saws.

The first "set" given was to keep the saw from binding and heating in the cut; and it was effected by bending a half dozen or more adjacent teeth to one side, and the next half dozen the other way.

We have learned a much better way to spread or "swage" the end of the tooth, so as to make a kerf wider than the blade is thick, and yet give each tooth a cutting action on each side.

This also obviates the disposition to spring into the wood, caused by "spring set" while the tooth is sharp. (The tendency of a *dull* spring set tooth is to spring away from its work.)

Fig 1 shows a hand saw, "spread set." The expression "jumping" is sometimes used for this operation.

We find that half the cutting time is lost, and the points are being dulled on the return stroke, without any advantage.

The M tooth is like two triangles set on the same base, and one pointing each way. (See Fig. 3.)

The action of a saw so toothed is precisely as though it were pulled out of the cut and turned end for end at each stroke. It takes no more metal to make an M than a V; there are just as many teeth to the foot and they are just as strong.

Furthermore there may be more teeth in a given space than if upright V's were made, and their cutting action is "sweeter" and keener.

The M tooth has been known a long time (Holzapffel showed it in 1846). But it was at first difficult to sharpen on account of the crotch in the M stripping the file corner and hence resisting the filer's efforts. For this reason there has, in some cases been cut out, a narrow kerf in the sharp crotch. This makes filing easier by removing some of the metal and by saving the file corners.

A variation of the M tooth is the W, largely used alone, and in combination with the M, in cross cuts. It is simply the M with sloping sides, and a wider base; is somewhat stronger, and nearly as keen.

We learn from the *Boston Journal of Commerce* that the contracts for the sewerage pumping engines for that city were awarded as follows:

Two high duty engines to Geo. H. Corliss, Providence, R. I, at about $45,000 each, and two Leavitt engines at about $107,000 each. The bids were as follows:

Geo. H. Corliss, 4 engines, $180,000; Quintard Iron Works, 4 engines, $435,000; I. P. Morris, 4 engines, $446,000; Holly Mfg. Co., 4 engines, $620,000; Reading Iron Co., 4 engines, $496,000, all for same service, and Mr. Corliss guaranteed the whole service.

EXTRACTS FROM CHORDAL'S LETTERS,

(*Concluded from Page* 3.)

"Every man gets good pay. But if you would go out in the shop, and make them change jobs they would starve, and Doolittle could keep them there, and raise their earnings as he did before. He knows what conveniences and advantages are. You spent a hundred and fifty dollars on what you called a perfect outfit for 'manufacturing' engines. Doolittle paid twelve hundred dollars out of his own pocket before he commenced on an engine, and he sent East for tools that you acknowledged you never had heard of. He knows how to help a man in his work and he charges big money for knowing how. I have been studying how we could kick our contract over, so we could pocket Doolittle's profit, but now I believe that if we kick the contract over, we kick the profits over, too."

* * * * Pete and Cady now have five contractors in their shop on different classes of work, and they see these contractors making more money than the shop, but they are smart enough to see that the shop and the men make money, too, and that the credit is due entirely and solely to the contractors.

* * * * Very respectfully,

CHORDAL.

AMERICAN MACHINIST

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Business Specials, 40c. a line.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ Subscribers who fail to receive their paper promptly will please notify us at once.

☞ Entered at the Post Office at New York, N. Y., as second class mail matter.

NEW YORK, JANUARY 24, 1880.

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Educating Young Machinists.

One of the most vital questions affecting the mechanical progress of our country, now prominently before us is, what steps shall be taken to properly instruct apprentices to the machinist trade, or, expressed in its broadest sense, what shall be done to insure the necessary training and skill among machinists? To any one who has not carefully examined this question, there would seem to be no cause for anxiety, for we are daily confronted with new and bright achievements of mechanical skill and ingenuity, but a series of inquiries will make plain the fact that these admirable productions of original effort are the work of a very few individuals.

The masses of machinists and artisans in kindred trades labor to construct what has been designed by those few The latter strive, by devising and introducing mechanism so automatic and so easily manipulated, to render a high grade of skill unnecessary in the former. Their success, while it elevates themselves, tends to render it more and more difficult for individuals of the other and far the larger class to obtain advancement. Division of mechanical labor has been carried to such an extent, by aid of the wonderfully perfect machinery and tools that have been brought into existence within the last ten years, that, in most manufacturing operations, no inconsiderable proportion of the work formerly done by adept mechanics, who were required to have served long apprenticeships in mastering the details of their trade, is now satisfactorily performed by common, unskilled labor, often by boys and girls. In brief, the tendency of modern shop practice is to sustain but two classes—mechanical engineers and machine feeders; the former to devise, construct, and superintend the mechanism used in the shop, and the latter to produce the goods. The demand for machinists is, therefore, limiting itself to two grades; those highly skilled, to whom good wages are paid, and those who know how to do but one part of the work, who must give their services for the lowest wages. As a consequence, there are very few shops that retain the old fashioned system of apprenticeship. Men can be trained in a brief season to perform certain specific branches of the work, and why should machine shop owners take the trouble to instruct beginners through a term of years, thus enabling them to command a high rate of wages, when unskilled help will satisfactorily perform, at low wages, the operations required? There is no difficulty in finding enough young men to go through the full course of apprenticeship, if the right kind of opportunities are placed within their reach. There are also ample facilities afforded by technical schools for those who have sufficient means to go through a course of mechanical engineering; but even those so well favored often find much difficulty in finding suitable places after graduation to acquire, by practice, that skill imperatively needed to enable them to fill responsible positions. What is needed, is, a course of apprenticeship to the machinists' trade, combining both theoretical and practical instruction, through which an industrious and energetic young man can pass, paying his way by his own labor.

Although many progressive and philanthropic machine shop proprietors have provided a course for apprentices with these ends in view, it is well known that the general system pursued in machine shops is such that these advantages can not often be afforded. Very few of them care to take apprentices at all, and the difficulties in the way of beginners are growing greater instead of less. The solution of the problem, so far as the instruction is concerned, could doubtless best be accomplished by amply endowed institutions like the Worcester Free Institute of Industrial Science, the machine shop of which not only pays running expenses but also a gratifying profit. We are pleased to see a movement in some of our larger cities towards the establishment of mechanical schools, provided with all the appurtenances for machine shop practice. While, by proper agitation of the subject through the medium of the press, and by the personal efforts of philanthropic citizens, liberal contributions towards endowment funds might be obtained, no more worthy object exists for appropriations by State, county or municipal authorities. After the expenses of fitting up have been met, these schools could, by good management, be made almost if not quite self-sustaining. The good they would accomplish in improving the mechanical status of the localities covered by their benefits would be incalculable. New plans must be adopted to educate the present and future machinists of America, and we suggest the above as fully meeting the requirements of the times.

Accepting Petty Bribes.

If there is one characteristic more than another, that marks the difference between the high-spirited, self-respecting man among men, and the ill-paid, unambitious drudge, it is a willingness, however disguised, to accept petty bribes for the correct performance of duty. The man who values his labor, whether of head or hands, as true manhood always does and always should value the results of its toil, when he fixes upon a price for his labor, expects and will accept no more, by way of bribe. The customer in Smith, Jones & Co.'s shop, for example, who finds himself under the necessity of feeing the foreman and several of the draughtsmen, workmen, or clerks, before he can be sure that his job is properly under way, or is certain to receive the careful attention, as to details, that the proprietor has agreed to furnish, is apt to conclude that there is a screw loose somewhere in the working of that shop. If the customer, by such feeing, succeeds in getting results that he has *not* paid for or agreed to pay for, the proprietor, in his turn, is apt to find, after a few years, that a succession of such jobs has left the balance hopelessly stranded on the wrong side of his ledger. On the other hand, the customer who attempts this method of getting his own due or the due of somebody else, when he finds foreman, draughtsman, workman or clerk rejecting the proffered bribe as an insult, however good-naturedly tendered, concludes immediately that system and honor are not empty words upon those premises, and his estimate of the merits and capabilities of the establishment rises at once. In short, that shop has made a friend, to the manifest advantage of future business.

And the indignant foreman, or other employee, what has he gained? First, he has risen in the good opinion of the customer. Where such a measure of integrity is found, ability is usually not far behind it. He, too, may have made a friend. Then, better than all, he has risen in his own estimation. And it is astonishing to note the difference in the bearing and future progress of nine men out of ten, who have really found themselves out in a noble action. The whole man rises at once to the level of his position, and begins to look for ways and means of reaching a higher position, and, under the guidance and stimulus of such a new and powerful force, the chances in his favor begin to grow in a way wholly unsuspected before.

Nothing need here be said regarding the practice too common among men in responsible positions, of taking secret commissions upon purchases or sales, which it is their duty to make with strict and sole regard to their employer's interest. That is an infamy which can have but one ending. Nor should anything be inferred condemning the propriety upon the part of employer and employees, of making or accepting suitable presents in a suitable way, and for a suitable purpose. Where such gifts are intended, not as secret bribes to secure the performance of duties which should be as faithfully rendered without them, but as marks of mutual esteem and appreciation, the distinction is obvious, and need not be farther enforced. But the results of the system, or rather lack of system, which either encourages or permits the practices indicated in the title of this article, are only evil, and that continually, to all parties in interest. Most of all are they of evil import to the workman, who soils his fingers with them, because, as the consenting party, he falls farther, and therefore has more to lose.

A gratifying feature attending the success of the AMERICAN MACHINIST is the substantial unanimity with which the old subscribers, who began taking the paper as a monthly, at one dollar per year, wheel into line as subscribers to the weekly, at three dollars. In changing to weekly, we thought it fitting that all our old friends should receive the weekly for the full term paid for by them for the monthly, and notified all to this effect. Notwithstanding this notice, a considerable number insisted upon remitting the difference; but such remittances have been uniformly credited, as covering so much additional time. Aside from its value, as showing appreciation of the merits of the paper, we are gratified to find this liberal action upon our part so well received. To us, losing the name of an old monthly subscriber from our mailing list for non-renewal is like losing an old friend. But losses of this kind are so few that we have had no sort of occasion to put on mourning.

The new year opens brightly with the AMERICAN MACHINIST in the way of new subscribers, as in every other direction. With the change from monthly to weekly, a steady run of new subscriptions set in, increasing steadily, until now there is hardly a town or city in this country, or hardly a civilized country under the sun, unvisited by it. A pleasing feature of its recent progress is the increasing favor it meets with in shops among the working force, from superintendent down to apprentices. We are daily receiving long lists of subscribers from foremen and superintendents, taken among workmen, as well as a large number of single subscriptions from the practical men at the heads of firms and companies, coupled, in almost every instance, with warm commendations of the conduct and character of the paper. Altogether, the business "boom," that we hear so much of in commercial circles, loses none of its force in eddying round the nooks and crannies of this office.

Notwithstanding repeated reminders to the contrary, we are daily receiving anonymous communications asking information of all sorts, which have to be consigned to the waste basket, because the writer has not signed his name. With every disposition to oblige our readers, we are compelled to take this course as a measure of self-protection. Let it be understood, that the writer's name must accompany every contribution.

In this issue, we introduce to our readers Mr. Frank C. Smith, a contributor, for whose practical writings we bespeak an attentive perusal upon their merits.

This week Mr. Chas. T. Porter reaches No. 10 in his series of articles on "The Advantages of High Speed Engines." We know from letters that we are constantly receiving, and special orders for the issues containing them, that these articles are being widely read. But where are the low speed men? Notwithstanding the challenge thrown out, when the first of the series appeared, not a single statement or deduction made by Mr. Porter has yet been controverted for publication in our columns.

Machinery Outlook for the New Year.

Elsewhere in our columns will be found a number of reports made to us, by leading manufacturers and dealers in machinery, regarding the present state of trade, the outlook for the new year, and probable course of prices. These columns will be regarded with peculiar interest at this time, affording, as they do, an accurate index of the condition and prospects of the machinery interest throughout the country. It will be seen that a singular unanimity of opinion prevails concerning the genuineness and permanence of the revival of business, showing that it is not

a short-lived spasm of activity, but a foundation upon which a strong and stately structure of prosperity may be erected.

One feature of the revival has hitherto received little attention, and that is the tendency of such times towards lengthening credits. So many business establishments are strained to the full capacity of their available capital and other facilities, owing to the increased volume of business done, that slow credits are natural, if not inevitable in many instances. This tendency is a manifest evil, and should be remedied, wherever possible.

Transmitting Power.

The transmission of power through long distances is deserving of more attention than it has received from the promoters of mechanical improvement. While power can readily be conveyed short distances by means of covered steam pipes, as well as by belts, shafts, and wire ropes, no method is in vogue for transmitting power for manufacturing, hundreds of miles. Whether this can be done economically or not is the question to decide. It has been pretty clearly proved that electricity, with the best appliances now known, is not economical for this purpose. If some plan can be put in practice for successfully storing up and conveying to a distance the immense power going to waste in Niagara and other waterfalls, its projector would be hailed as one of the greatest of public benefactors.

Recent developments in the use of compressed air for driving street cars, seem to indicate that something more important may be looked for in the production and transmission of this kind of power.

Compressed air can be bottled up in iron reservoirs and sent out over the country like soda water ready for use, when required. In our Jan. 1878 issue we illustrated and described an air compressor to run by water, designed to store up power for transmission. Let some genius apply this plan to practical work.

LITERARY NOTES.

ELECTRIC TRANSMISSION OF POWER. Its present position and advantages. By Paget Higgs, LL. D., author of the Electric Light and its Practical Application, illustrated; crown, 8 vo. cloth; 90 pages; price, $1.20. Published by E. & F. N. Spon, 446 Broome Street, New York. Sent post-paid to any part of the U. S.

Every one who is in any way connected with machinery is aware of the benefits to be derived from an economical method of transmitting power. Where distance is to be considered, none of the present systems are so perfect as not to leave room for improvement, therefore manufacturers are fully awake to the necessity of some simple and effective means by which power can be transmitted long distances. During the past few years the practical applications of electricity has worked wonders; and it is generally believed that it is to work in the future still greater and important parts in the transmission of power. The above work is largely the result of trials by the author, who is a well-known experimentor. The different electric machines are fully illustrated and explained, also their advantages and disadvantages. Some serious objections are offered against the practical application of electricity, and are fully explained, as well as the important and more definite advantages of its proper application.

The book will doubtless be found very interesting to the student of electricity, also practical mechanics.

THE WORKSHOP COMPANION. A collection of useful and reliable recipes, rules, processes, methods, wrinkles, and practical hints for the household and shop. 165 pages. Price, 35 cents. Published by the Industrial Publication Co., 14 Dey Street, New York.

The design of the publishers of this book has been to give practical information, and, so far as we are able to judge, they have succeeded very well. It has evidently been prepared by a practical man. Many of the formulas are worth much more than the price of the whole book, some being entirely original. The subjects are arranged alphabetically, so that any subject can be readily found. This work is particularly adapted for the use of amateurs.

The January number of the *National Car Builder* comes out with a spick and span new suit of clothes, under its new ownership and management. Mr. R. M. Van Arsdale, widely known in railway circles, has purchased the paper, and will doubtless be able to impart all the energy needed to make the *Car Builder* even more popular than it is now, among the practical men for whom it is designed. The editorial management remains unchanged.

Business Specials.

Forty cents a line for each insertion under this head.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co., New York, or the author, Manchester, N. H.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, Piermont, N. Y.

Tool Chests with best tools, scroll saws, wood and designs. Amateurs' and Machinists' Tools. Send for Catalogue. Tallman & McFadden, Philadelphia.

Steel Stamping Figures and Dies.—1-16" to 1-8" Figures, per set, $1.00; 1-8" Letters, $3.00. American Tool Co., Cleveland, O.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) W. W. E., Rochester, N. Y., writes: Will you kindly inform me how ornamental frosted work is done on cast iron? What kind of a scraper is used? I have tried to do this several times, but never having seen it done I fail to make as nice a job as I could wish. *A.*—Ornamenting or scraping surfaces is a business of itself, and requires long and careful practice. A very practical essay on scraping and finishing metal surfaces is contained in The Complete Practical Machinist, by Joshua Rose.

(2) J. C., San Francisco, Cal., writes: Can you inform me who is the best author on erecting engines and machinery in the machine shop, also how to take the lengths of rock-arms, setting valves, how to find center lines and work from the same, marking off work for the machinists, etc.? *A.*—We know of no American work published that covers the vast amount of manipulations that you require, but we refer you to an English work entitled The Mechanician and Constructor, by Cameron Knight, 4to cloth, 1147 illustrations and 397 pages. Price $15. This work contains all, and more than, you have asked for, and is a practical work written by a practical man. We also recommend that you procure the back numbers of the AMERICAN MACHINIST as they contain much valuable matter on this subject that you desire.

(3) W. E. S., Lowell, Mass., writes: I have been running a hoisting engine, and, as I like the work, I would like to know: 1. Which would be best for me to do: to keep on running the engine until I get a chance to run a stationary, or go into the shop and learn the machinist trade? The only objection to the last plan is, that I cannot get pay enough to support myself. *A.*—Examine yourself and ascertain what you are best adapted to, and then push ahead. A person who would make a good engineer would not always be a success as a machinist. 2. Which is the best situation, that of a stationary or a locomotive engineer? *A.*—The situation of a good stationary engineer is preferable to running a locomotive, as it is not as severe on the constitution and nervous system of a man, and is attended with less danger. 3. Give me the names of two or three good, cheap books on steam engineering. *A.*—Edwards' Catechism of the Marine Steam Engine; price, $2.00. For the other books, see Machinists' Library in our issue of August 2, 1879. 4. I can get a situation to fire a set of stationary boilers; would you advise me to take it? I am 19 years of age, and desire to earn all the money I can while laying the foundation for a good trade. *A.*—We have had many queries sent to us, similar to this, and we can say no more on this subject than what is contained in our answer to the 1st question in our issue of Nov. 15, 1879.

(4) E. R. C., Lapeer, Mich., writes: We have a Silsby Steam fire engine that has always done first-class work until a heater was put on to supply hot water, since which the steamer when started primes or foams badly, and continues so until the water in the boiler has been worked off, when it settles to good work. Does the heater affect the water, or can you give a remedy? *A.*—We believe from your statement that there must have been some oil or something of an oily nature left in the heater that you speak of, which would cause the boiler to foam. If such is the case a little common washing soda put into the boiler will prevent the foaming. The heater and pipes should be carefully examined and thoroughly cleaned.

(5) G. W. F., Salem, Ohio, writes: Will you please inform me as to the latest and best work on the Steam Engine Indicator? *A.*—Richards' Steam Engine Indicator, by Chas. T. Porter, London Edition. Price $2.50. This is not new, but is considered by engineers to be a valuable and complete work on this subject, and contains all that you desire. Q.—Will you prescribe a course of study for one who is desirous of learning theoretical steam engineering, who has some slight practical knowledge thereof? *A.*—We would advise you to master A Treatise on Heat, by Thos. Box, also Porter's Indicator (above referred to) which you will find of very great practical value.

MANUFACTURES.

J. A. Fay & Co. (Wood-working Machinery, 267 to 285 Front Street, Cincinnati, Ohio, write us:

The out-look has never been better with us. We are crowded to the utmost, and in many departments two months behind our orders, which come from all over the world: East, North, South, and West. We are receiving orders from Russia, Germany, England, Scotland, Ireland, Australia, New Zealand, South America, Brazil, British Guiana, West Indies, Mexico, Japan, China, East Indies, and many other countries, which, added to our volume of home-trade, makes it very large, and the prospects for the new year were never more flattering with us than now. We are expecting an advance in prices to meet the recent advance in material and labor. We are continually increasing our works; adding new and improved machines to keep pace with the times and demands. We flatter ourselves that we turn out as much, if not more, work per man than any other shop in this country. Our splendid equipment and facilities enable us to do this. Our list embraces almost every variety of machine required in the conversion of lumber.

The Worcester Machine Screw Co., Worcester, Mass., write us:

Our business, at the present, is booming, and we are overrun with orders. Prices have an upward tendency, and the prospects are very good for a large business the coming year. We are about moving into our new factory, built expressly for us, when we shall be able to double our business.

A machine tool firm of Worcester, Mass., write us:

Business in our line (Machinists' Tools) never was better in Worcester than to day; most, if not all the makers are working on orders, and have nothing on hand finished, and productions for the next six weeks or two months all sold. Stock of all kinds has advanced within the last two weeks, and wages have an upward tendency, and as a result of this, makers of machinists' tools advanced prices Jan. 1st, about ten per cent.

Thus far, prices of machinists' tools have not kept pace with the advance of stock, (castings, bar-iron, and steel), and it is believed must advance in price again soon.

Chester Steel Casting Company, office 407 Library Street, Philadelphia (works, Chester, Pa.), write us: Have doubled the capacity of our works in last four months by erecting large additions to our buildings, and by putting in a much larger engine and boilers, furnaces, etc. Have all we can do with our increased capacity and force. Are now filling orders from nearly all the locomotive builders in the United States, and from many of the steam engine builders, machine shops, and railroad companies.

Poole & Hunt, Baltimore, Md., (Turbine Water-wheels, etc), write us:

Our business has been better during the last year than for several years previously, but the price of manufactures has not kept up with the great rise in materials. In our *special line*, the "boom" has not yet amounted to much, but we have not expected it, and are not disappointed. Our time, we believe is coming, and we have great confidence in the near future.

The Albany Steam Trap Co., Albany, N. Y., write us:

Our sales for the last year were fully fifty per cent. greater than they were the year before, and our future prospects are certainly good, from the fact that our suits sustaining our patents are terminating favorably to us.

Wm. Sellers & Co., Philadelphia (Machine Tools), write us:

Our business generally is improving.

Cope & Maxwell M'f'g. Co., Hamilton, Ohio, write us: The business out-look for the new year is very encouraging in our line of manufacture (steam pumping machinery). The demand for large mining pumps and pumping machinery in general is very good indeed, with a great deal more of inquiry for prices than since the beginning of the panic. Prices have not kept pace with the rise in prices of raw material and labor, yet we think there will be an improvement in this respect, if there continues to be a firmness in prices of raw material, as many persons have been of the opinion that iron was simply inflated and would soon have a reaction, resulting in lower prices; but from the present out-look it is going to last for some time, and parties will be compelled to buy such things as are wanted at an advanced rate, just as manufacturers have to pay the advance on raw material and labor.

David W. Pond, Worcester, Mass. (Machine Tools), writes us;

Very busy; increasing force of help; need more first-class machinists; prospects favorable.

Merchant & Co., 525 Arch St., Philadelphia (Metals, &c.), write us:

We, with pleasure, add our testimony to the general comment as to a better feeling and actual experience of a healthier state of business than has existed in our line of business for several years past. The cry, by some, that the better times are "more apparent than real," is not verified by our experience or that of our friends.

Although prices have been on the advance for the past three or four months, the demand has also increased for tin plates, sheet copper, seamless brass and copper tubing, sheet iron, metals, &c., and every evidence points to a large business for the coming year. Our views are based, in some measure, upon the demand we have had during the month of December, which has been very large compared to former years, for, during this month, consumers do not purchase any more than current demands require.

Woodbury, Booth & Pryor, (Steam Engines) Rochester, N. Y., write us:

There was a very large increase in our sales during the last half of the past year, and our business altogether more satisfactory. We have advanced our prices from time to time, and the wages of our workmen. The outlook for the year now opening is much brighter than for years past.

Wishing the new year may be a happy and prosperous one to the enterprising and sprightly MACHINIST, we remain, etc., etc.

Heald, Sisco & Co. (Engines, Pumps, etc.) Baldwinsville, N. Y., write us: We would cordially reciprocate the compliments of the season and hope that you "may live long and prosper." Business with us is exceedingly prosperous. Orders crowd in and keep us about a month behind, even with one shop running on extra time, and with the electrical light, which is brighter and cheaper than daylight. Prospects for the ensuing year are cheering. We shall not, probably, change our present prices. We have all the help that we can possibly employ with present facilities. If there is an Americanism by which we can express the present status and the future prospects of our engine and pump trade, it would be by saying—business *booms* and bids for the *best*.

The Betts Machine Co., Wilmington, Del., write us:

The present condition of the machine tool trade is very much more active than it was a year ago; the inquiries for tools have been very numerous during the last four months especially. Prices must surely advance with

the increased cost of metals and wages. Skilled labor is far from plentiful: the prospects for a good trade have not looked so bright since the panic set in. Stability in prices generally is now most desirable; sudden advances and reactions are very damaging.

The Buckeye Engine Co., 42 Coal and Iron Exchange, New York, write us: The prospects for the coming year are uncomfortably encouraging, inasmuch as we cannot accept one-half of the business offered. Have nearly doubled our capacity during the past year, and expect to double again this year. Now working 24 hours per day, about 220 men in double gangs. Were compelled to make an advance in price in November last. Our prices are held firm, being as close as business will justify. Have no immediate further advance in contemplation, but in this respect we are at the mercy of the iron and labor market, which will undoubtedly be higher before it is lower.

The Lehigh Valley Emery Wheel Co., Weissport, Pa., write us: Our business was heavier in December than any previous month this year, or in fact for three years—with large orders unfilled, which will run us through January; our prospects were never better. As to prices, *they should be advanced*; all kinds of raw material are advancing, but we will not be the first to take this step. We have been laying in a large stock, in anticipation of the advance, and have material enough on hand to run a year at least, if our trade should be double what it was last year, and we have no doubt it will be.

Bliss & Williams (Presses and Special Machinery), Plymouth, Pearl and John Sts., Brooklyn, N. Y., write us:

The business prospect for the coming year is excellent. Our recently greatly increased facilities are now taxed to the utmost to meet the demands of our customers.

Tin and sheet metal manufacturers seem anxious to avail themselves of the newest processes and the best machinery and tools, and the general feeling is one of encouraging confidence.

Scleicher, Schumm & Co. (Otto Gas Engines), 3045 Chestnut St., Philadelphia, write us:

Our shop is taxed to its full capacity. Orders are coming in freely, notwithstanding we have to ask two months for filling them. Our prices have been advanced in proportion to the rise of value of iron and metals. For the year 1880, we anticipate a steady, good business for our specialty.

A. H. Downer, 17 Peck Slip, New York, writes us: The prospects for the New Year, so far as Anti-Incrustation Boiler Liquid is concerned, are flattering. I have met with nothing, so far, that improved A. I. B. L. will not surmount. To put it in expressive language, "it knocks spots out of scale" in steam boilers. You can, therefore, readily see that when the public become convinced of the utility of the article, *it will go*, provided it is properly pushed.

L. B. Eaton, (Machinists' Supplies) 11 N. 6th St., Philadelphia, writes us:

Prospects for the coming year never better than at present. Things never looked so healthy. The new year will see an advance in all mechanics' tools, though there may not be an advance to the consumer on some tools. Some goods have been sold at large discounts. Files will advance, sure, and 25% discount will be bottom. I have advanced some goods 25% to 40%. Am well satisfied with my year's business.

John Adt (Wire-Working Machinery), 20 to 26 Artisan Street, New Haven, Conn., writes us:

The New Year opens for me with a larger number of orders on my books than at any time during the past seven years. I have not made, nor have I in immediate contemplation, any considerable advance in prices of my standard specialties in wire-working machinery and hardware manufacturer's tools, though I am paying more for all grades of labor than last year at this time, and prices of material have, of course, advanced somewhat; and though profits are thereby diminished, yet I look for my indemnity in the increase of business, which the maintenance of low prices will be likely to insure. The only drawback to an otherwise perfectly satisfactory condition of affairs is, that for some months past I have found collections rather slower than usual.

Fitchburg Steam Engine Co., Fitchburg, Mass., write us:

Our business has for three months been steadily increasing, and is now giving us all we can drive to with a full force of men. We have now about 45 all told, and are putting in more machinery to accommodate the increased demand.

We have received in the last four months orders for 58 engines, having 22 now on our books unfilled—a large part of them large engines comparatively; as two of 200 h. p.; three of 100 h. p.; two of 50 h. p.; five of 40 h. p.; three of 30 h. p., etc. We have not had since eight years ago prospects anywhere near such as the present. The tendency of prices is upward, but stock advances faster proportionately than the finished work, the balance being preserved by the increased amount of work turned out. Prices will "even up" in time. Allow us to congratulate you upon the marked success your journal has deservedly attained. We welcome its weekly appearance as that of an old friend and instructive acquaintance.

Wm. Wright (Steam Engines), Newburgh, N. Y., writes us: "I never was so full of work at this time of the year as at present. I now have orders that will tax my capacity for three or four months, and since January 1st the inquiries and orders have increased over last year. I am stiffening on prices to meet advances in pig metal; cannot give you any percentage of increase, however. The outlook is good for business to be very active the present year at greatly increased prices."

The Consolidated Safety Valve Company, Boston, write us: We have actual orders on hand for our "Pop" Safety Valves, to keep us busy for four months to come. We have just shipped a number to Canada.

Ruffner & Dunn (Excelsior Boiler Tube Cleaners), Schuylkill Falls, Philadelphia, write us:

Our business is in a flourishing condition; so much so that we can scarcely fill our orders; and we expect a heavy increase the present year, with but little or no change in prices.

The Goulds Mfg. Co. (Pumps, &c.), Seneca Falls, N. Y., and 15 Park Place, New York City, write us: Business with us is about as usual, having all we can do. We don't think that the prospect for spring is quite as flattering as some manufacturers are inclined to think and believe. But the rapid advance in everything that enters into the construction of our goods has been so material that we think it will have a tendency to check the demand.

Erratum in Questions and Answers.

In the hurry of making our first form ready for printing, a partially incorrect answer was given to Question 4, in the present issue. Washing soda should not be put into the boiler, but the grease should be cleaned out of the heater. It may be heated up, and the grease burned out.

Machinists' and Engineers' Supplies.

NEW YORK, Jan. 8, 1880.

The supply business continued brisk up to a late hour on Dec. 31st, 1879, and began still more lively at an early hour on the morning of Jan. 2d, 1880. There is a general advance all round, and no one assumes the right to say where it will stop.

When we go into an office now to gather items for our machinists' and engineers' supply column, the dealer, on being made acquainted with our business, raises both hands above his head, looks bewildered, and exclaims: "Oh! there is nothing new, except that everything is going up, and we don't know where it will stop." It is impossible to get any stock on hand, and it is with the greatest difficulty that orders can be filled. Most of the manufactories are running nights to fill their orders.

The advance in Boiler Tubes, predicted in this column two or three weeks ago, has taken place, the discount allowed being now 5 and 5%, at 30 days cash.

The National Tube Works announce 25% discount on Wrought Iron Pipe.

The price of machine bolts advanced 10 per cent. yesterday.

Hammers, sledges, picks, chisels, and all forged goods are still advancing.

It is reported that machinists' small tools, such as calipers, dividers, and finished tools will advance 10 per cent. about Feb. 1st.

The Nicholson File Co., Providence, R. I., have issued the following notice to the trade, under date of Jan. 1st, 1880:

NOTICE.

We would call your attention to the fact that, for the present, we have very few goods to sell, our shelves being almost bare of stock, and our product largely engaged ahead, notwithstanding our works have been pushed to their utmost capacity.

Our extensive improvements, now about completed, will soon add quite largely to our product, but until we can get something of a stock of goods to offer, we see no reason for any immediate change in prices, unless it be to advance them in self-defence.

NICHOLSON FILE CO., W. T. Nicholson, Pres.

Attention is called to the following notice:

NEW YORK, January 10th, 1880.

We take pleasure in informing our numerous customers that we have just fitted up our new store at 95 Fulton Street, in this city, in an entire new building, erected upon the site of the old one occupied by us as a depot for Machinists' and Jewelers' supplies since 1816.

We have also just received new importations of staple articles, such as Stub's, Grobet's and Vautier's Files; Renard's, Nicoud's and Vautier's Gravers, also Pierson's and Bourgoine's Chasing Tools.

As we laid in our stock before the rise of prices, we are able to fill orders at old rates.

With lately increased facilities we are now able to fill orders for Hall's Cutting Nippers promptly.

With a New Year's greeting to both old and new customers, and assuring them of a welcome to our new store, we remain, YOURS respectfully,

PETER A. FRASSE & CO.

The Russell & Erwin Mfg. Co. quote Japanned Wood Screws discount 30 and 10 per cent.

Copper Rivets and Burs have advanced to discount 25%.

Millers Falls Vises are advanced to discount 10%.

Peter Wright's Anvils have advanced to 10½ to 11¼ c. per lb. net.

Augers and Bits are now quoted 40 and 10 % discount.

The American Screw Co. have advanced flat head Iron Machine Screws to discount 65%; round head, 60%; Taps for Machine Screws, 45%.

Coes' Wrenches have been advanced to discount 40% genuine; second quality, 10% less.

Iron Review.

NEW YORK, Jan. 8, 1880.

The demand for Iron continues very large, and prices have again been generally advanced all along the line. The mills seem independent of orders and, as a general rule, either refuse to quote or ask figures much beyond even present ones. The same state of things exists in England and on the Continent, and those who looked for lower figures here, based on foreign Iron will be disappointed, as advances there keep full pace with any here. The year 1880 promises to be a very busy and profitable one. At the last quarterly meeting held at Birmingham, England, prices of market bars were advanced 20 to 40 shillings.

Pierson & Co., 24 Broadway, New York, furnish us the following quotations out of store, under date of Jan. 8, 1880.

No. 1, X Pig, $35 to $36 per ton; Iron Rails, $50 to $60, according to weight; Old Rails $38 to $40; Fish Plates, 3⅜c. per lb.; Railway Spikes, 3¾c.; Bolts and Nuts, 4½c.; Common Bar Iron, 3 2-10c., basis from store; Refined, 3½c., basis; Ulster, 4 2-10c., basis; Machinery Steel, 7c.; Best Tool Steel, 13c.; Norway Bar Iron, 6c.; Norway Shapes, 6½c.; Nail Rods, 6½c.; Sheet Iron, 4½c., basis; Angle Iron, 4c.; Tee Iron, 4½c; Band Iron, 4c.; Hoop Iron, 4 3-10c.; Horse Shoe Iron, 4c.; Hot Polished Shafting in lengths, 2 ft. and longer, 7 to 8c., according to size; Small Black Rivets 40% off in papers, 25% off in bulk.

A. B. Warner & Son, 28 West St., N.Y., furnish us the following store prices to-day of boiler-makers supplies: Flange, 6c.; C. H. No. 1 Shell, 5c., C. No. 1, 4½c.; Boiler Tubes, 5 & 5% discount; Sheets, 5c. Further advances are expected every day.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of Jan. 8th, 1880:

The Metal Market is fairly active, demand good, and a strong upward tendency prevails. Pig Tin is firm, spot and futures, and notwithstanding speculators hold considerable stocks, not a pig is offered on market. London quotes Straits Tin £93. We quote Banca Tin, 24¾c.; Malacca and Straits, 22c; Billiton, 21¾c; "Lamb & Flag," 21½c. Pig Lead firm at 6c., with prospect of still higher prices. Antimony 17c. to 20c. as to brand; Ingot Copper, 21½c.; Spelter, steady and strong; Domestic, 6¼c. to 6⅜c.; Foreign, 6⅜c. to 6½c.; Nickel, $1.25; No. 1 Solder, 11¾; "half-and-half," 13½c.

Situations Wanted—Help Wanted.

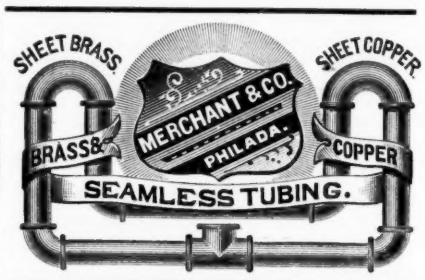
We will publish notices suitable for the above headings, applying to any of the machinery trades, and not to exceed four lines each (32 words), at the nominal rate of twenty-five cents for each insertion.

Manufacturers requiring the service of a Mechanical Engineer and Draughtsman, who can take the lead in designing and constructing first-class Steam Engines and Mill work, will please address A. P., AMERICAN MACHINIST, 96 Fulton Street, New York.

Wanted a situation by a competent Mech. Eng. and draughtsman as Supt. of Machine Shop or draughtsman, address A. E. W. care American Machinist, 96 Fulton Street, New York.

A practical mechanic, having seven years' experience in designing and constructing first-class machinery, wants a place. Good references for ability and faithfulness. Address, WILLIAM A. LORENZ, 363 Macon Street, Brooklyn, N. Y.

Parties desiring a good practical and reliable machinist as foreman who understands managing help and is well qualified for general jobbing or specialties, can find one by addressing A. S. Granville, Lawrence, Mass.



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For sale by all Machinists' Supply Stores.

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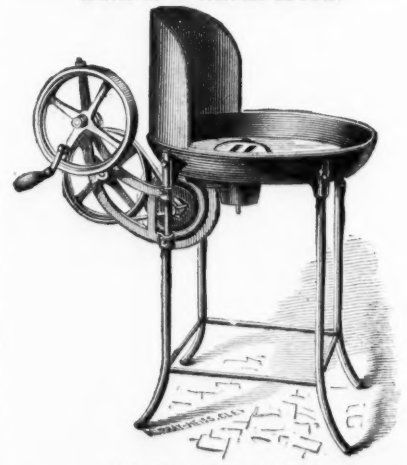

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Superior in every respect to all other Regulators.—Controls steam pressure within *one pound. Fully* opens or closes with *less than half* the variation of pressure required by any other Regulator. Every Regulator adjustable to any pressure, from one pound upwards. In three months it will *repay cost in economy of fuel*, besides insuring steady power, economy of repairs and safety from explosion. Prefer to have pressure mentioned when ordering. Price, $38.50. Thirty day's trial allowed before paying. **American Steam Appliance Co., 13 & 15 Park Row, New York. Sole Manufacturers.** 28 SCHOOL STREET, BOSTON, MASS.

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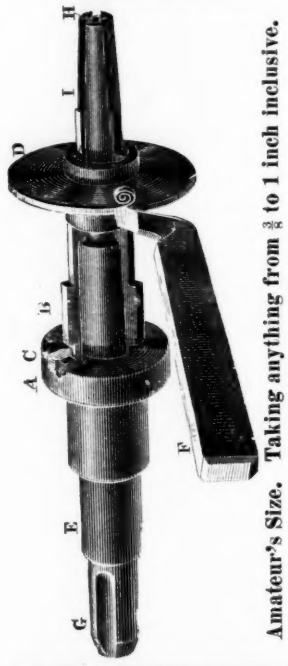

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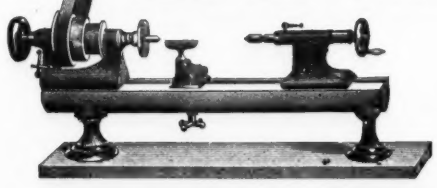

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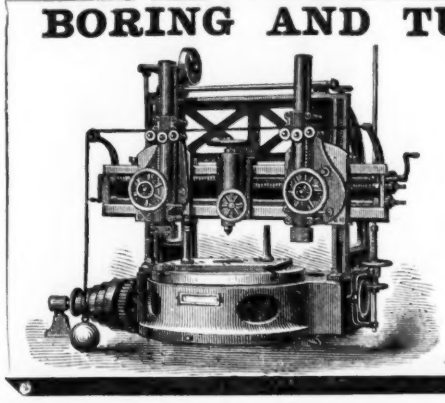

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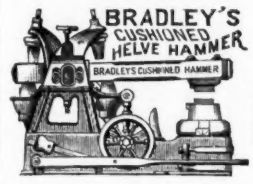

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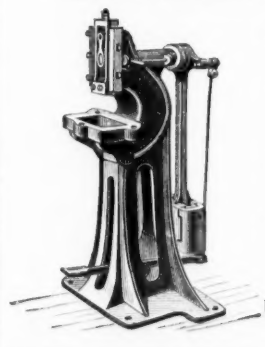

Punching, by foot, *3-4* hole in *5-16* iron 6 inches from edge.
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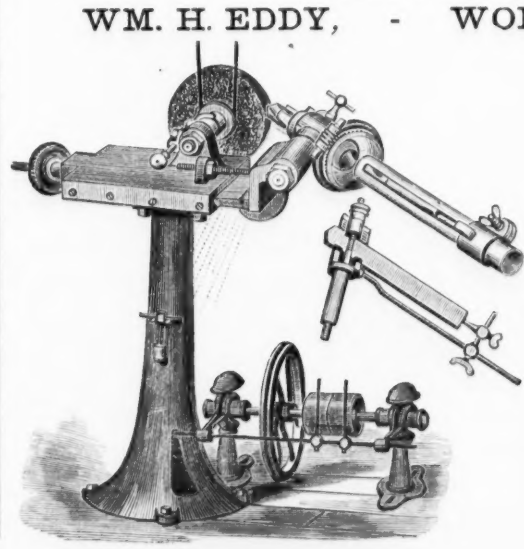

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It enables the operator to make the cutting edge or lip of the drill thick and strong, so it will not crumble away in drilling, also to make the side surface.

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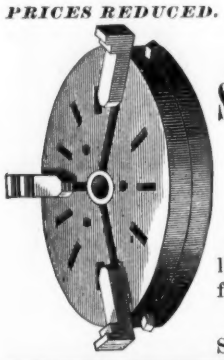

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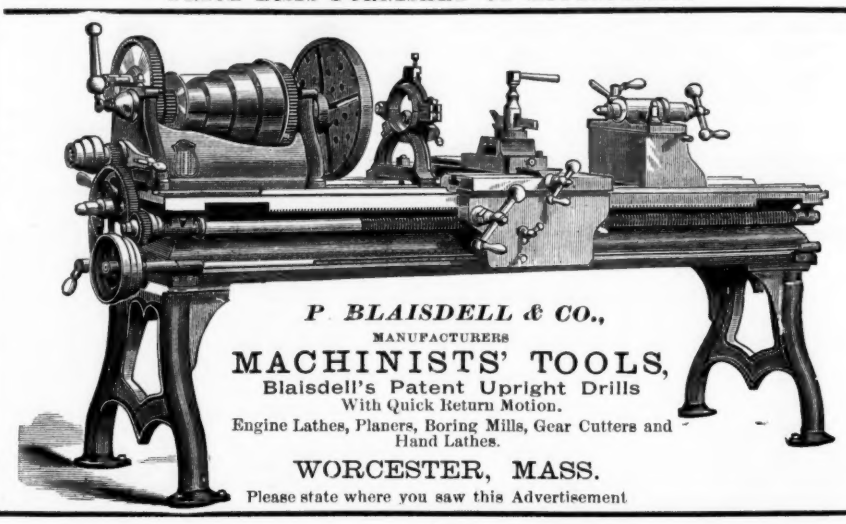

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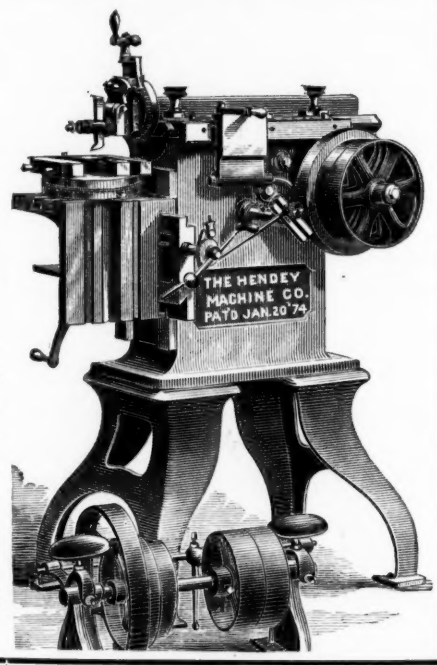

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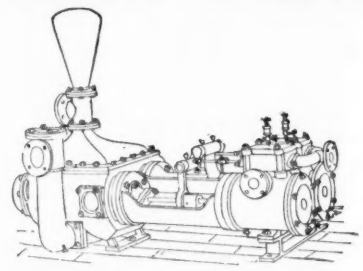

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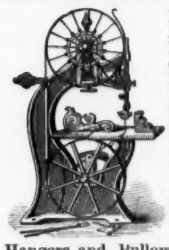

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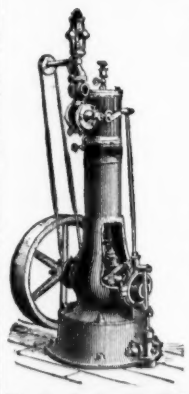

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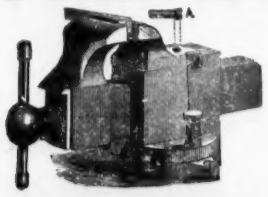

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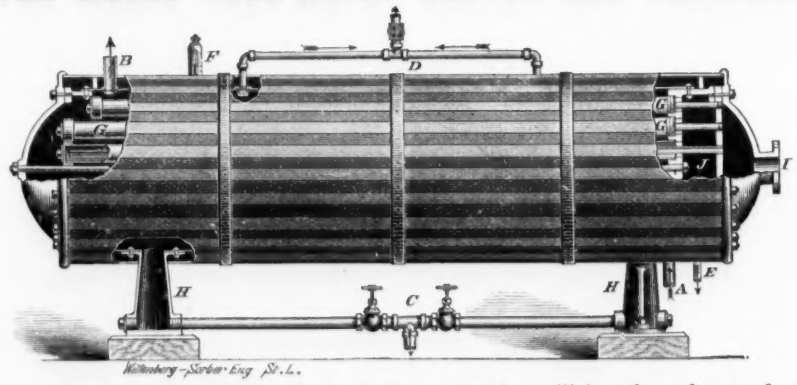

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NOTABLE ARTICLES.

Original articles by *thirty-one* of the best writers on mechanical subjects, were contributed to the AMERICAN MACHINIST, as below. Copies containing these articles can be ordered through any newsdealer at ***6 cents*** each.

Prof. John E. Sweet.
Defects in Building Engine Lathes. June 28, 1879.
A Novel Centering Device. July 19, 1879.
Engine Construction. August 9, 1879.
Prevention of Injury from Machinery. Sept. 13, 1879.
Bits of Experience. Oct. 11, Nov. 15 and 29, 1879.

Chas. E. Emery, Ph.D.
Marine Governors. October 18, 1879.

Park Benjamin, Ph. D.
Safes and Safe Breaking. Nov. 1, 1879.
Concerning Trade Literature. Nov. 29, 1879.

John J. Grant, M. E.
Standard Gauges and Tools for Accurate Measurements. May, 1878.
The Lathe and its Uses. August, 1878.
To prepare a Shaft Properly for Turning. Oct., 1878.
To Turn a Shaft properly. December, 1878.
To Bore and Turn a Pulley properly. July 5, 1879.

John W. Hill, C. E.
Strength of Steam Boilers. July, 1878.
The Properties of Water. August, 1878.
Composition of Fuel. September, 1878.

Charles T. Porter.
Advantages of High Speed Engines. August 9, 16, 23, Sept. 27, Oct. 11, 18. Nov. 15, 29, Dec. 20, 1879.

John W. Nystrom, C. E.
Horse-Power of Steam Boilers. Nov. 22, 1879.

"Chordal."
Extracts from Chordal's Letters, in every issue since July, 1878, except March, August 30, Sept. 27, Dec. 6, 1879, and Jan. 10, 1880.
Balancing Pulleys. August, 1878.
Scraped Surfaces. August 30, 1879.
A Mechanical Time Keeper. July 5, 1879.

L. F. Lyne, M. E.
Practical Method of Setting the Valves of a Locomotive. November, 1878.
Boring Locomotive Cylinders. December, 1878.
Faulty Construction of Locomotive Boilers, Management, &c. January, 1879.
Improvement in Slide Rests. May, 1879.
Use and Abuse of the Engine Lathe. June 28 and August 23, 1879.
Use of the Ratchet Drill. July 12, 1879.
Oil Stones and their Uses. August 9, 1879.
What Constitutes a Good Lathe. August 30, 1879.
Use of Lubricants. September 20, Nov. 1, 1879.

Wm. Lee Church, C. E.
Piston Speed of Engines. September, 1878.
Engineering Popularized. Jan., Feb., March, April, May, June 28, July 19, Aug. 16, 1879.
Talks. Nov. 22, Dec. 20, 1879, Jan. 10, 1880.

Charles A. Hague.
Engine Duty and Indicator Cards. April, 1879.
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Wm. H. Hoffman, M. E.
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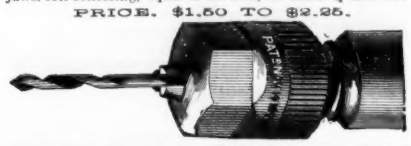

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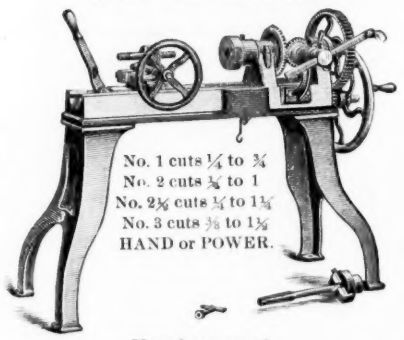

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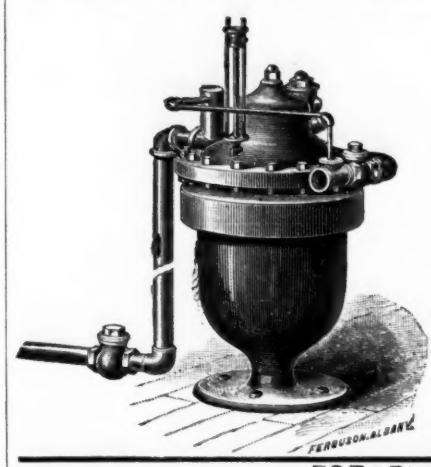

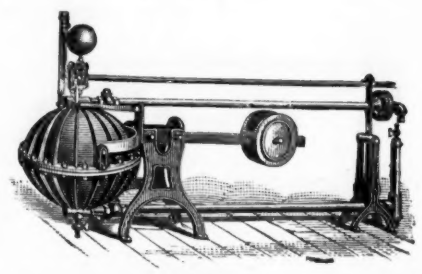

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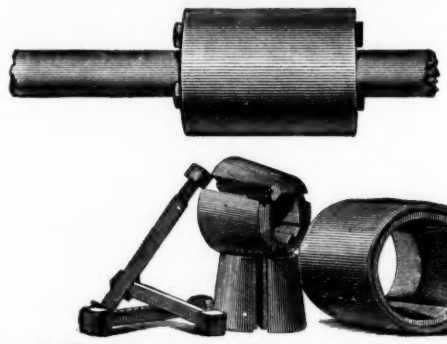

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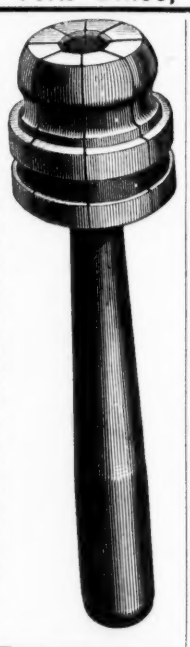

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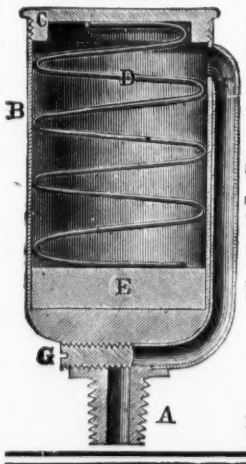

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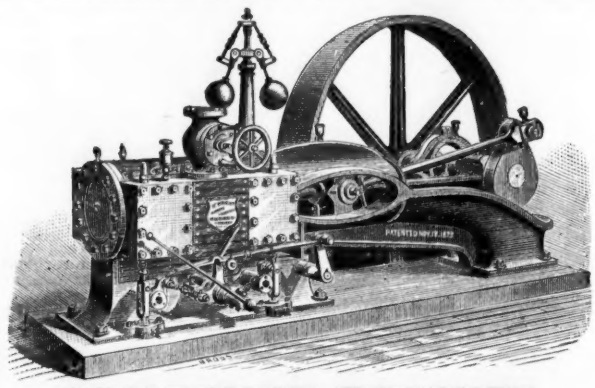

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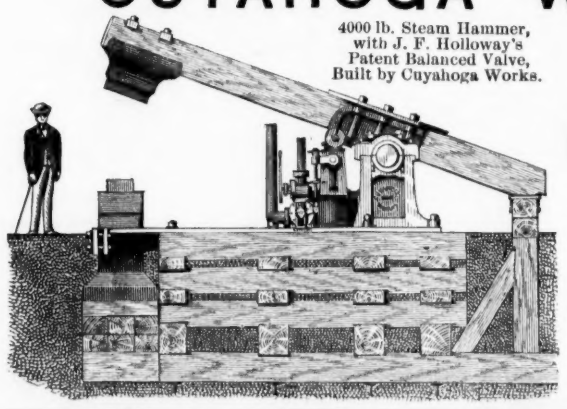

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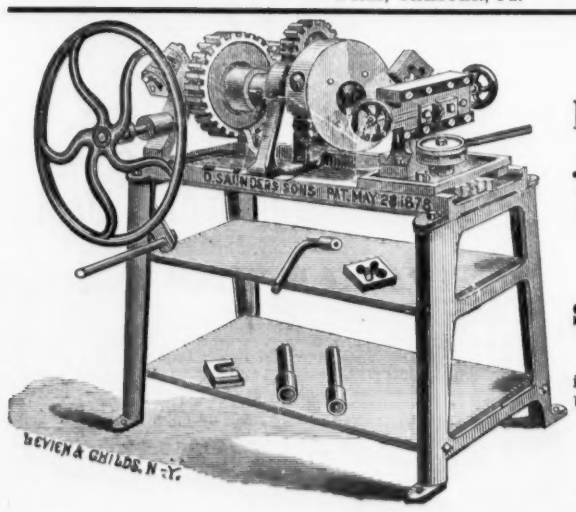

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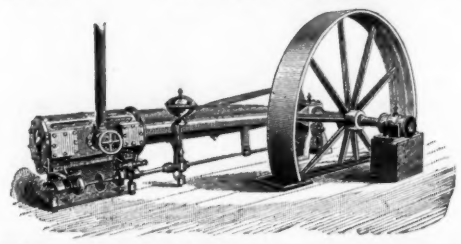

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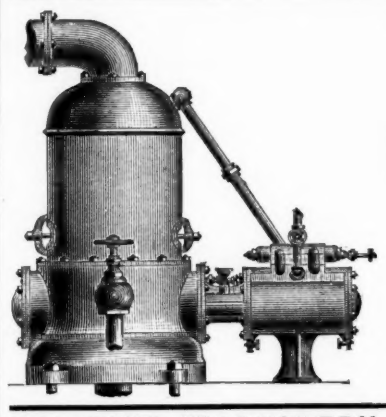

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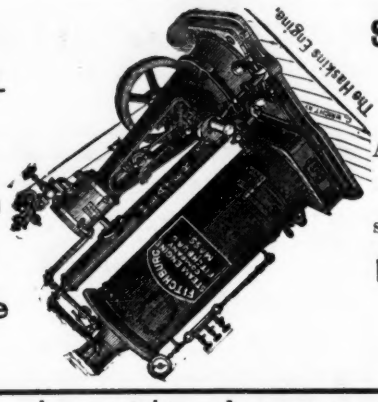

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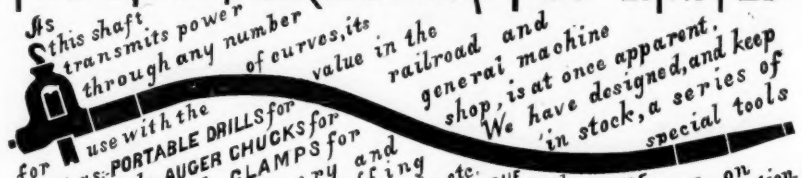
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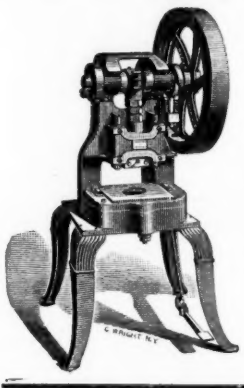

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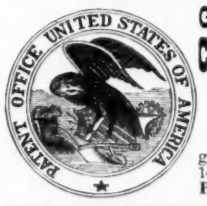

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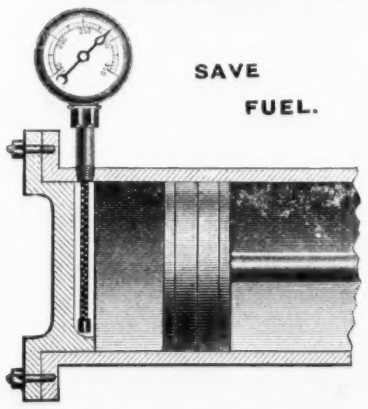

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One Planer, 30 in. x 7 ft.
One " 30 in. x 6ft. Wheeler.
One " 24 in. x 4 ft. W. L. & Co.
One " 22 in. x 4 ft. Wheeler.
One " 22 in. x 5 ft. " New.
One Crank Planer, 24 in. stroke.
One 24 in. stroke Shaper. Hendey. New.
One 8 in. stroke Shaper. Gould.
One 8 in. " " Pratt & Whitney.
One Brown & Sharpe Universal Milling Machine.
One No. 3 Garvin Milling Machine.
One Garvin Cutter Grinder. New.
One Combined Cutter and Reamer Grinder, with Threading Tool Grinder attached. New.
One 27 in. Swing Upright Drill. New Bk. Geared and Self-feed.
One 24 in. " " " P. & W. Self-feed.
One 21 in. " " " Wheeler.
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One Gear Cutter.
One each No. 0 P. & W. 2 and 3 Spindle Drills.
One each No. 1 P. & W. 3 and No. 2, 4 Spindle Drills.
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One No. 4 Stile's Punch Press.
One No. 1 Wilder Punch Press. New.
One No. 4 " " " Geared. New.
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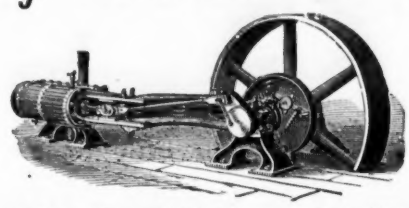

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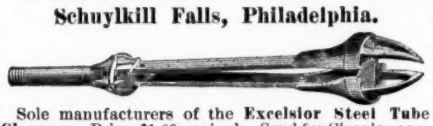

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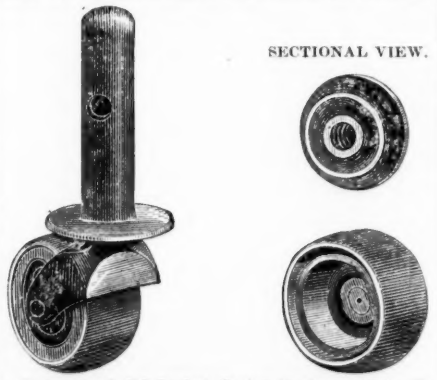

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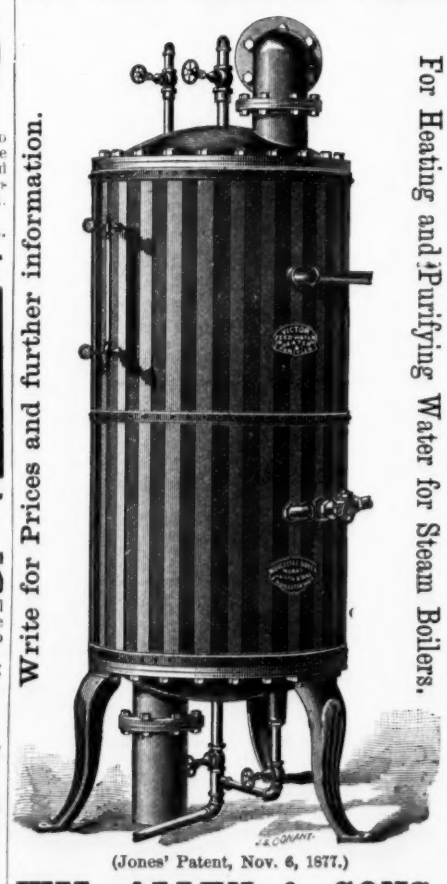

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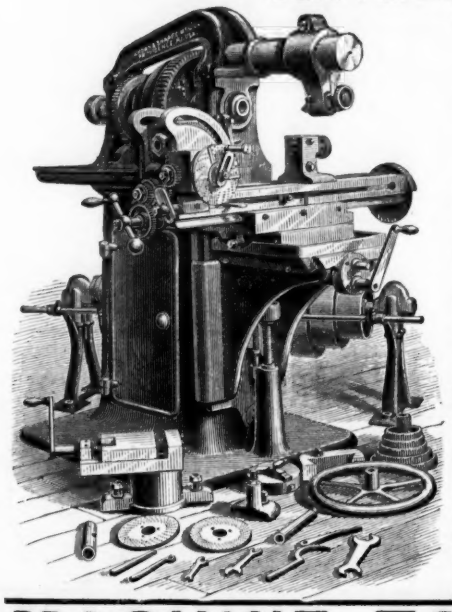

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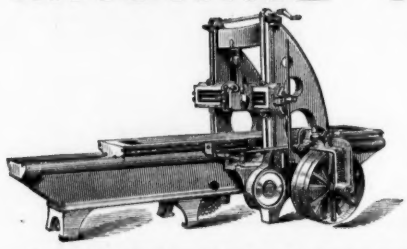

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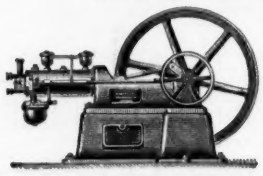

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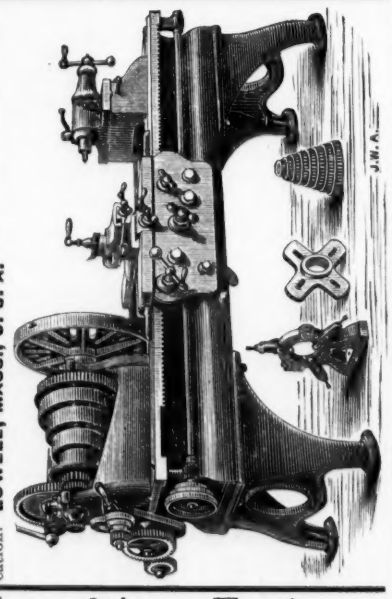

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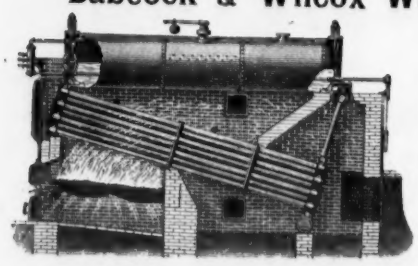

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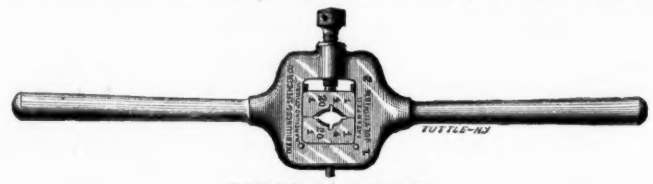

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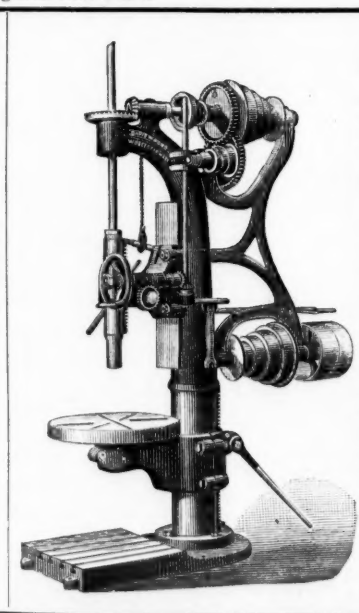

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